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STATE OF NEW-YORK.

No. 200.

New York (State) Natural History Survey
Communication from the Governor

IN ASSEMBLY,

February 20, 1838.

COMMUNICATION

From the Governor, relative to the Geological Survey of the State.

TO THE ASSEMBLY.

I have the honor herewith to transmit to the Assembly, the annual reports required from the persons engaged in the geological survey of this State. By the law authorizing this important work, the direction as to the mode of executing it, is committed to the Governor. He communicated to the last Legislature the arrangements he had made in performance of the duty thus devolved on him. It was thought expedient by the Governor, that the persons engaged in this survey, should have an opportunity of consulting together, and making such suggestions to each other and to him, as to the manner of executing it, as would be likely to produce the best results.

On the invitation of the Governor, they assembled in November, 1836. In addition to the arrangements which had been made to carry into effect the views of the Legislature which authorized the survey, the board recommended that a person should be employed, to be denominated a Palæontologist, whose exclusive duty it should be to execute that part of the work which related to *fossile remains*. This recommendation of the board, together with the reasons by which it was sustained, the Governor submitted to the Legislature at the last session, with a view to ascertain how far the suggestion was likely to meet with its approval. The resolutions of the Assembly, the branch of the Legislature to which

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the reports of the geologists, and the communication of the Governor accompanying them, were transmitted, left it to his discretion to adopt or reject the recommendation of the board. (See Assembly documents, No. 258.) Upon mature consideration of the subject, he concluded that this further division of the labors of the surveyors would facilitate the execution of the work, and make it more complete; he has therefore adopted the suggestions of the board in this respect.

Mr. Timothy A. Conrad, who had been previously employed as the geologist of the third district, was selected as a person peculiarly fitted for this part of the survey. *James Hall*, who was an assistant geologist, was appointed to the place made vacant by appointing *Mr. Conrad*, the Palæontologist. The third and fourth districts have been reorganized since the last report to the Legislature, and *Mr. Vanuxem* assigned to the third, and *Mr. Hall* to the fourth.

It has also been deemed expedient to dispense with the assistant geologists. Those which had been previously employed have not been discharged, but no new appointments have been made to fill vacancies. There is now but one assistant engaged in the survey. An allowance, which if necessary may be equal to, but in no event is to exceed, the compensation paid to an assistant, is made to each geologist who has not an assistant, to be applied to procure aid and assistance in executing his duties. The sum thus expended by the geologists, it is anticipated, will be in most instances less than the salary allowed to the assistants, and in this way some reduction in the expenses will be made, without diminishing the value of the services to be rendered to the State.

The rate of compensation allowed to the persons employed in this public work are nearly or quite the same as that reported to the Legislature at the last session, but the incidental expenses exceed the sum expended in the previous year. Particular care has been taken in adopting and carrying out the arrangements for the completion of this enterprise, to bring the annual expenditure within the sum specified in the report of the Secretary of State in 1836.

From the reports which I herewith send to you, and from other sources of information, I feel warranted in assuring you that the work is progressing with rapidity; that those employed by the State are executing it with scientific skill, and persevering industry; and that the results of their labors in developing our internal resources, and adding to the wealth of the State, will be quite equal to the high expectations which have been formed of the usefulness of this public enterprise.

Accompanying this communication, I transmit:

I. A letter from *James E. De Kay*, the zoologist, in relation to annual reports from the zoological and botanical departments.

II. Report of *Lewis C. Beck*, who has charge of the mineralogical and chemical department.

III. Report of *T. A. Conrad*, who has charge of the Palæontological department.

IV. Report of *W. W. Mather*, geologist of the first district.

V. Report of *E. Emmons*, geologist of the second district.

VI. Report of *L. Vanuxem*, geologist of the third district.

VII. Report of *James Hall*, geologist of the fourth district.

W. L. MARCY.

Albany, *February* 20, 1838.

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LETTER

Of J. E. De Kay, on the Botanical and Zoological Department of the Survey.

To His Excellency Gov. Marcy,

Sir:

I have this day presented to you a verbal report of my labors during the past year, and have laid before the joint committee of the Senate and Assembly, to whom the subject is referred, evidences of the faithfulness with which the part allotted to me has been performed. From the nature of the duties of the Botanist and Zoologist, you will have perceived that they cannot make partial reports, until their labors are brought to a close. I trust that you have received satisfactory evidence from both, that they are actively engaged in their respective duties, and that you can confidently look forward to their successful termination.

I am, sir,
With great respect,
Your obedient servant,
J. E. DE KAY

February 3d, 1838.

REPORT

Of Dr. Lewis C. Beck, on the Mineralogical and Chemical Department of the Survey.

To His Excellency William L. Marcy,
Governor of the State of New-York.

Sir—

In conformity with the provisions of the act authorising a Geological Survey of the State, I beg leave to present the following report of the progress made in the Mineralogical and Chemical department during the past year.

In the early part of the season, the investigations which principally engaged my attention during the preceding year were followed up by the examination of several deposits of metallic minerals in the counties of Orange and Lewis. Accompanied by my friend, Dr. William Horton, who is intimately acquainted with the mineralogy and geology of Orange county, I visited several of the localities for which this portion of the State has so long been celebrated. Among these were some valuable beds of iron ore, which I shall briefly notice.

The *Wilks*, or *Clove mine*, which is said to have been worked about forty years, is situated two or three miles northwest of the village of Monroe, in the town of the same name. The ore, which is the magnetic oxide, is sometimes quite pure and breaks into granular fragments; at others, it is largely mixed with the sulphuret of iron, and some earthy minerals, which injure its quality. In one part of the bed, the ore resembles that which is called *fine ore* by the miners, to which state it has probably been brought by the decomposition of the iron pyrites. Masses of well characterized hematite, or hydrous peroxide of iron, are found associated with the magnetic iron, and the same mineral occurs in considerable quantity on the surface near this mine. I have not, hitherto, observed these ores so immediately connected with each other.

The *O'Neil Mine*, about a mile and a half south of the Wilks mine, is an extensive bed of magnetic iron, which is mixed with a portion of silica, and is associated with carbonate of lime. This mine, I believe, is at present owned by the Hon. G. Kemble, and is extensively worked. The ore is hard and compact, and often contains beautiful cubic and octahedral crystals of magnetic iron. Some other minerals of great interest occur at this locality.

Forshee's Mine, is an extensive bed of iron ore in a hill of gneiss about half a mile from the preceding. The general direction of the deposit is nearly north and south. In one part, the magnetic iron having a compact structure, follows the direction of the strata, but this soon passes into a granular ore and an earthy oxide of a dark brown color resembling umber. The granular ore has a cavernous appearance as if a part had been dissolved out. I am inclined to believe that these varieties have been produced by the decomposition of the sulphuret of iron, which is still found abundantly disseminated through the lower strata. Delicate fibres of asbestus, also frequently run through the compact ore; and garnet, serpentine and tremolite, are found in the immediate vicinity of the mine.*

The ore from this bed is highly valued by the iron masters in this part of the county, especially that portion of it which is granular and decomposed. This last does not contain any sulphur, and is employed without the preliminary operation of roasting.

To the above, may be added the ***Rich Iron Mine***, three-quarters of a miles from the Monroe iron works, near the summit of the highlands in this part of the county. This is a bed of magnetic iron, in a primitive rock, and is said to have been formerly worked, but is now abandoned. Some of the fragments of the ore are highly magnetic, and have an octahedral form. Other specimens are charged with iron pyrites, which is continually undergoing decomposition.

The county of Lewis undoubtedly possesses great mineral wealth. Although my excursions were necessarily limited, I examined several localities of the ores of iron and lead, which, if not important in themselves, seem to render it probable that valuable deposits of those metals exist in their vicinity. Iron sand is abundant on the shores of Moose and Black rivers, and massive magnetic iron is found in various parts of the county. I also visited several beds of yellow ochre a few miles from the residence of the Hon. Francis Seger, who accompanied me to those localities, and to whom I am indebted for several facts concerning the mineralogy of this, hitherto, almost unexplored portion of the State.

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* A short distance from this mine is a fine locality of Mica; some of the plates are of a large size. One of them was nearly three feet in diameter, but in consequence of its being exposed to the weather it was fractured in the form of rhombic and triangular plates. Dr. Horton and myself succeeded in obtaining a specimen about twenty-two inches in length and tolerably perfect.

Near Martinsburgh and Lowville, are several veins of sulphuret of lead, in the limestone, which there constitutes the rock formation. Some of these have already been worked, at least to a moderate extent, but I believe without profit. Yet the conclusion is perhaps warranted by the facts, that important veins of this ore will hereafter be discovered in the vicinity.

While at Martinsburgh, Mr. Conklin, of that place, informed me of the existence of a bed of black oxide of manganese, a few miles distant. On visiting it with that gentleman, we found the locality in question on the summit of Tug hill, about two miles from the village of Houseville. The deposit of the ore is in marshy ground, and varies in depth, as at present exposed, from three or four, to eight inches, being made up of rounded masses of various sizes. It is somewhat doubtful whether this bed is an extensive one; but the value of the ore, and the purity of the specimens which we obtained, certainly warrant further and more extensive examinations.

I have, during the past season, visited the counties of Orange, Westchester, Albany, Oneida, Lewis, Madison, Onondaga, Cayuga, Wayne, Monroe, Livingston, Genesee, Niagara, Erie and Chautauque: and have collected several hundred specimens illustrative of their mineralogy, which are ready to be arranged as soon as a proper place shall have been provided for them.

Although I have thus been from time to time collecting materials for the final work on the mineralogy of the State, my attention, since the date of my former report, has been chiefly directed to the study of our mineral springs, of which I now propose to give a general and condensed account. And as the design of these reports seem to be to inform the public of the progress of the different departments of the survey, and to illustrate the utility of the undertaking, I have also introduced some remarks on subjects of practical importance. In short, my object has been to show, so far at least as this department is concerned, the benefits which may be expected to result from the thorough examination of the State, now in the course of prosecution.

MINERAL SPRINGS OF THE STATE OF NEW-YORK.

The mineral springs of our State are much more numerous than might be supposed. With a very few exceptions, we have within our limits, examples of all the different varieties which have hitherto been described. Some of these are of acknowledged importance, as the brine or salt springs, which are of frequent occurrence; others, as the carbonated and sulphuretted springs are highly esteemed for their medicinal properties, and have on this and other accounts, become places of great resort and sources of wealth, not only to their proprietors, but to the community at large.

In the account which I am about to give of our mineral springs, I shall not confine myself to the results of my own observations and analyses, but shall refer to such works and papers as have been published concerning them.

I shall adopt the following as the most convenient classification, viz:

1. Brine springs, or salines.
2. Gas, or carburetted hydrogen springs.
3. Nitrogen springs.
4. Carbonated, or acidulous springs.
5. Sulphuretted, or sulphurous springs.
6. Petrifying springs, with a notice of their products.

BRINE SPRINGS OR SALINES OF THE STATE OF NEW-YORK.

Geographical view of the brine springs.—Brine or salt springs, the waters of which contain a large proportion of common salt, and are not charged with a sufficient amount of carbonic acid to be placed in the class of acidulous or carbonated springs, are of frequent occurrence in the western parts of the State. They have not hitherto been found east of Salt Springville, on or near the line between the counties of Otsego and Montgomery, about fourteen miles from Cooperstown. The springs at this locality, like many others to be hereafter noticed, although containing a very small proportion of salt, formerly afforded supplies of this important article to the inhabitants in their vicinity. In the strongest of these waters, the amount of saline matter does not exceed three or four per cent. This locality, however, is interesting in a geological point of view, as it occurs in the second greywacke of Mr. Eaton, a formation much older than that in which the great brine springs of this State are found.

In nearly the same parallel of latitude with the preceding, in Delaware county, a brine spring was discovered in 1833. It is situated upon Elk brook, about four miles from the village of Delhi. We are informed that a well has been bored about 400 feet in depth, 350 being through rock, and that during the boring, several veins of brine were struck, from which some salt has been manufactured.

Proceeding westwardly, we find brine springs near Vernon Centre, in Oneida, and again about nine or ten miles farther west, in the same county. These, according to Mr. Eaton, are the first brine springs in the red or saliferous rock of western New-York. And here, as in various parts of Ohio, they are accompanied by carburetted hydrogen gas, which in some cases is evolved in large quantities.

At Lenox, in Madison county, a brine spring was discovered some years since, of such strength as to induce several persons to believe that it might be advantageously employed in the manufacture of salt. But these anticipations have not been realized, and the locality deserves to be noticed only in the geographical view which I am now presenting.

A short distance west of the above point, brine springs have been found at intervals for upwards of a hundred miles in a range, a little west of north. Thus, near the Chenango Forks, in Broome county, salt water has been found by boring. It is said also to occur in the county of Cortland. We next come to the celebrated springs of Onondaga county, to be particularly described hereafter. And finally, we have in nearly the same range several weak brine springs in Oswego county. One of these occurs in a marsh in the town of Hastings, four miles west of Central Square. Two miles west of this is another, while at Central Square is still another. Neither of these salines, however, are of much importance, as the amount of saline matter which they contain seldom exceeds twelve ounces in the gallon of water. Similar salines exist also in the towns of Constantia, Richland, Hannibal and Stirling, in the same county.

The brine springs of Montezuma, in Cayuga county, come next in order. These have been long known and extensively worked; and although the manufacture of salt from them has, within a few years past, greatly declined, they are still second in importance only to the Onondaga springs.

Wayne county contains several salines. Those at Galen were at one time in considerable repute. Works were erected there at great expense, but these have been long since removed, and the manufacture of salt entirely abandoned. The reason of this will be apparent, when it is stated that the brine contains scarcely 9 per cent of solid matter, as appears from an analysis of it made some years since, by Mr. G. Chilton, of New-York.* There is also a brine spring near the head of Little Sodus bay, in this county, on the farm of Mr. Switzer. Of this water, Mr. Conrad informs us that one hundred and forty gallons are required for a bushel of salt, a strength still inferior to that of the former, and which prevents it from being advantageously employed in the manufacture.†

Again, in the village of Clyde, on the canal, salt water with inflammable gas, has been found by boring. The boring was 400 feet in depth. The brine yielded, at first, twenty ounces of saline matter to the gallon, but it soon ceased to flow, or was much diluted with fresh water.

A few salines are known to exist in the county of Monroe. One of these, found many years since, is on the Irondoquoit Bay, two or three miles from Lake Ontario. Salt was at one time manufactured from this brine. Another spring, also formerly somewhat worked, is in the town of Greece, two miles north of the ridge road, and nine miles west of the city of Rochester.

I was informed by Mr. E. K. Horsford, of Moscow, that salt water had been found in 1834, two and a half miles southwest of York, in Livingston county. Strong brine flowed for a few days from the mouth of the well, which was fifty feet in depth, but it subsequently diminished in quantity, and at length entirely ceased to rise.

Salt water has been found by boring in the town of Elba, in Genesee county, eight miles northwest of Batavia; and this, together with the brine springs in the towns of Murray and Richland, in Orleans county, are the most western localities hitherto discovered in this State. At Holley village, in the latter county, a brine spring occurs, from which a considerable amount of salt has been obtained. And in the town of Ridgeway, the same article has been made in quantities sufficient for the consumption of the inhabitants.

Salt water was said to have been found in the county of Cattaraugus, but I have not been able to satisfy myself of the correctness of this assertion. From the frequent occurrence of gas springs in Chautauque county, it is not improbable that brine will be found associated with them, as it is in various parts of the State of Ohio.

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* Silliman's Journal, vii. 344.

† Mr. T. A. Conrad's Geological Report for 1837.

From this brief notice of the localities of the brine springs in this State, it appears that they occur with little interruption, from the county of Otsego to Orleans and Genesee, a distance of not less than a hundred and seventy miles, nearly east and west; and from Broome county nearly north, to within a short distance of Lake Ontario, being about eighty miles. It is, however, well known, that favorably as many of these springs are situated, none of them are at present employed to any extent in the manufacture of salt, except those found on the margin of the Onondaga lake. This fact proves most conclusively the superiority of the last mentioned springs, the great importance of which has never yet been fully appreciated.

Chemical composition.—In regard to the chemical composition of the waters of these different springs, great uniformity is found to prevail. All those which have been subjected to analysis, contain, although in somewhat various proportions, the chlorides of calcium and magnesium, and the carbonate and sulphate of lime, in combination with the common salt. All of them, moreover, when freshly drawn, give the characteristic test of iron, which exists in minute proportions in the form of carbonate. Bromine is also known to be one of the constituents of the Salina brine, and it will probably be found in most of the others; but iodine has not yet been detected in any of them. It may be interesting to observe, that all these ingredients are found in sea-water, although the order of combination is somewhat different. In the brine, the proportion of carbonic acid and of iron is usually greater, while that of magnesia is less, than in sea-water; and iodine, which has not been detected in the former, is frequently found in the latter. And to show, that so far as it regards the chemical nature of these substances, there is no inconsistency in the theory that these brine springs result from the solution of beds of rock salt, it may also be stated that all the saline matters which they contain are met with in rock salt, except that the chloride of magnesium is either entirely wanting in the latter, or exists only in very minute proportion. The rock salt of Droitwich and Cheshire contains the chloride of calcium, but not of magnesium. These facts, although they appear to be of little importance, may hereafter be found to have some bearing upon the views which are entertained concerning the origin of our salines, to be now considered.

Origin of the Brine Springs.

The origin of the brine springs of our State is a subject of the deepest interest, and no pains or expense should be spared for its complete elucidation. It has already been stated that, in consequence of the superior strength of the Onondaga brines, they are almost the only ones from which salt is manufactured in this State. Now if brines of still greater strength could be obtained, by boring or otherwise, it would increase the value of this manufacture, inasmuch as it would reduce the expense of the process and the price of the salt. Whether such a desirable result is within the compass of probability, can be determined only by a careful examination of all the circumstances connected with the occurrence of these springs.

Upon the supposition that the whole of the interior of this continent was originally covered with the waters of the primeval sea, it is not difficult to imagine that these waters may have remained in various places after the general subsidence, and that by long continued evaporation they may have been brought to the state of concentration which we find in these brines. The extent to which this evaporation must have been carried in the present instance, will appear from the fact that sea-water rarely contains more than four per cent of saline matter, whereas the Salina brine yields fourteen or fifteen per cent. But a serious objection to this theory of the origin of our brine springs is, that they are usually at some distance below the surface of the earth, where it is difficult to see how the process of evaporation can take place. Moreover, if the increase in the strength of the brine was due to this cause, it would be fair to infer that this process of concentration was still going on, and that the brine was constantly though gradually becoming stronger; of which there seems to be no proof.*

Professor Eaton has advanced the opinion that the brine is produced by combinations continually in progress between the elementary materials furnished by the subjacent rock, and some of the superincumbent strata.† This view is thought to be supported by the fact observed by him, that crystals of salt were formed upon a fragment of the saliferous rock, when exposed to a moist atmosphere. Another fact turned to the same account is of sufficient interest to merit particular attention. It is the occurrence, in the saliferous rock, of hopper-form cavities and crystals, resembling those of salt formed during an intermission in the application of heat, and commonly known by the name of *Sunday salt.* There are several localities in which these curious productions can be examined. In some cases the hopper-form cavities only are to be found, but in others there are entire strata of regular crystals. Of the latter, the finest exhibition that I have seen, is on the route of the Auburn and Syracuse rail-road, about half a mile from the village of Camillus; where for some distance the marly clay, which undoubtedly belongs to the saliferous series, is made up entirely of these crystals, varying in size from one to eight inches. In their dry state they contain sixty or seventy per cent of carbonate of lime, mixed with alumina, silica and the oxide of iron. Some of them have their surfaces covered with an incrustation of pure carbonate of lime, and have their bases slightly rhomboidal. After an attentive examination of this interesting locality I was led to the conclusion that these had originally been crystals of common salt which had been dissolved out, and the moulds thus formed again filled with clay, and subsequently incrusted by the percolation of water charged with the carbonate of lime. That this latter process has been going on extensively, is evident from the enormous quantities of calcareous tufa which are found in the immediate vicinity.

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* According to Dr. Benjamin DeWitt, the specific gravity of the Salina brine in 1801, was from 1.078 to 1.110. (Transactions of the Society of Arts, &c. I. 268.) In 1810, Mr. George Chilton found the specific gravity of the Onondaga brine to be 1.0958. (Silliman's Journal, VII. 344.) In 1826, I found it to be, 1.10800, and in 1837, 1.0884. So that if any reliance is to be placed on these observations, there does not appear to have been any appreciable alteration in the strength of the Salina brine for the last thirty-six years.

† Canal Rocks, p. 108.

A writer in the Philosophical Magazine and Annals of Philosophy, for 1829, from a review of the facts stated by Mr. Eaton, thinks the water limestone intimately pervaded with the chloride of sodium, which the moisture of the atmosphere, acting upon an exposed specimen, and the water of the springs acting upon the rock *in situ*, extracts and dissolves. Hence, carbonate of lime is found in these brines, while the brines of the Cheshire and Droitwick springs in England, which arise from the direct solution of rock salt, to which no carbonate of lime is immediately contiguous, are either entirely free from it, or contain only a minute proportion.

The same author suggests that the crystals of chloride of sodium, which formerly existed in the strata, were deposited at the era of the formation of the saliferous rock, by the same agency, which in other parts of the world produced beds of rock salt; and the salt has simply *been dissolved out* at a subsequent period by the percolation of water through the superincumbent strata, leaving impressed in the rock cavities bearing the forms of the crystals, and such without doubt, he affirms, has been one source of the brine springs of this district.

In confirmation of this view, a fact mentioned in Townson's Hungary is also adduced, viz: that the lowest beds of marl in the great salt mines of Wielicza are mixed with salt in small patches and cubes. If water were to percolate slowly through this bed, the salt would be dissolved, and cubic and other cavities left in the marl, if of a texture sufficiently compact, which would then present a similar appearance to the beds above described.

But this theory, although so plausible at first sight, does not, it appears to me, satisfactorily account for the formation of the large and solid crystals found at Camillus. The occurrence of mere cavities may perhaps be well enough explained in this manner, but it should be recollected that the entire stratum of several feet in thickness is a mass of crystals. It is worthy of suggestion, that these crystals, although they have the form of those of common salt, may have had this form impressed upon them by a very small admixture of that substance. Thus it is known that when a small portion of solution of sulphate of iron is added to a solution of alum, and the whole allowed to crystallize, the sulphate of iron assumes the octahedral form of the alum, although these octahedral crystals contain scarcely a trace of the latter salt. As igneous action was probably concerned in the consolidation of this rock, it is in perfect accordance with the above fact to suppose that the crystalline form of this clay may have been derived from a small portion of salt which they formerly contained. It is certain that this clay is composed of carbonate of lime, silica, alumina and oxide of iron, but does not contain a trace of common salt.* Its occurence therefore cannot be considered of sufficient importance to warrant the conclusions which have been drawn from it concerning the origin of the brine springs.

Eleven years since I ventured to assert, as the result of an examination of the Onondaga springs, that the most plausible theory was, that they originated from a solution of beds of fossil salt.† This opinion, although quite generally adopted by those who are most familiar with the history of these springs, was nevertheless opposed by some individuals for whose views on subjects of this nature I entertain the highest respect, and I therefore feared that the grounds upon which it rested, were insufficient. But after the most careful review of the subject during the past season, I have again been brought to the conclusion, that of all the theories which have been proposed to account for the formation of these springs, there is none so free from objection as that which ascribes it to the solution of beds of fossil salt.

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* There is a clay found in the immediate vicinity of this crystallized stratum, which is often incrusted with crystals of sulphate of magnesia. A specimen which I analyzed, contained in addition to the carbonate of lime, silica, alumina and oxide of iron, about twenty per cent. of carbonate of magnesia. The hopper form crystals may also sometimes contain the latter salt.

† New-York Mediical and Physical Journal, v. 176.

I will now briefly state some of the facts which favor this view, and notice some of the objections which have been urged against it. In the outset, however, it should be observed that most of them are applicable to the immediate vicinity of the Onondaga springs; nor does it follow as a matter of course, that if fossil salt exists in their vicinity, it must necessarily be found near all the brine springs of the western region which have been enumerated. There are many instances of the occurrence of brine springs in England and France, at a considerable distance from any hitherto discovered bed of salt; and it is only when the brine has attained a certain degree of strength that this mineral is to be looked for in the immediate vicinity.

A boring was made several years since at Vic, in the very centre of the saline district, in the department of La Meurthe, in France. They first passed through strata of free-stone and clay, intersected by veins of sulphate of lime. At the depth of about fifty metres, the clay and sulphate of lime which the borer brought up, began to be mixed with rock salt, and continued so till about the sixty-fifth metre, at which the bed of rock salt began.

The account adds that at the present time (September, 1819,) the boring has reached to 85 metres; thus passing through more than twenty metres of salt, divided into three beds by the thin strata of sulphate of lime, and the borer continues to bring up salt.

It may not be unimportant to observe, that in the neighborhood of this boring, brine springs had been worked before the christian era; and that the above is the only locality of fossil salt which is known in France.*

In noticing the salt mines of Hallein, in Hungary, Beudant remarks: "We observe in the midst of these clays, beds of salt sufficiently large, grey or reddish, and containing in some places, pellets of argillaceous matter. We find especially fibrous gypsum, some veins of anhydrite and beds of a brown compact gypsum of a grey lustre, and somewhat scaly fracture."†

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* Ann. de Chim. et de Phys. XII, 48, or Repertory of Arts, second series, XXXVI, 186.

† Voyage Mineralogique et Geologique en Hongrie, pendant L'annee, 1818. Par F. S. Beudant. I, 169.

The account given of the salt springs of Worcestershire, in England, by an accurate observer, Dr. Charles Hastings, applies in almost every important particular to the region around the Onondaga springs. This author remarks, as others have done, that "wherever rock salt is met with, sulphate of lime or gypsum seems to be very generally discovered in mixture with the earthy strata above it. In most parts of the world where these gypseous strata are found, marine shells are mixed with them; but this has not been discovered to be the case either in Cheshire or in this county."

Dr. Hastings gives the following section from the surface in the town of Droitwich: "First, a stratum of mould, three feet deep, then a stratum of red marl forty feet deep, which abounds with water of a brackish nature. After that, a stratum of marl which extends for one hundred and thirty feet. In this marl there are no springs of water; it is quite dry, but is penetrated with perpendicular veins of gypsum. At the distance of a hundred and thirty feet from the commencemeut of the gypsum in the marl, we come to the strong brine, which rushes up to the surface as soon as it is bored into. This brine is ten feet deep, and the rock salt is under this river of brine."*

I have introduced these notices of particular localities of rock salt, rather than the general ones contained in geological treatises, because the facts can be the more easily applied to the case under examination. And it may be observed that the most prominent of these is the constant associations of gypsum with the rock salt formation.† In this particular, the similarity of the formation around the Onondaga lake appears to me to be fully established. About a mile from Syracuse, on the rail-road from that village to Split Rock quarry, is a conglomerate made up of pebbles of various sizes and colors, and firmly aggregated by an argillaceous cement. This stratum is three or four feet in thickness, and continues for some distance. In the marsh about a mile and a half from Syracuse, is an extensive deposit of marl, similar to that found in the immediate vicinity of Onondaga lake; and large masses of calcareous tufa are also found in this valley.

Beyond this bed of marl are extensive beds of gypsum, of the several varieties which are known to occur in western New-York, viz: the lamellar, the fibrous, the dark colored and the earthy. The specimens of the fibrous variety are more beautiful than any which I have heretofore seen from this State, the fibres being often more than two inches in length. But by far the largest proportion of the gypsum at this locality is in thin layers of the fibrous or foliated kind alternating with the dark colored earthy variety, which is indeed nothing more than a gypseous clay. It may also be stated, that both the rock and the clay associated with this mineral, effervesce strongly with acids, and contain a large proportion of carbonate of lime.

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* A Lecture on the Salt Springs of Worcestershire, (England,) with an appendix, by Charles Hastings, M. D., F. G. S.

† This is by no means confined to the *anhydrite*, as has been asserted, but includes also the hydrous gypsum exactly similar to that found every where in the western part of this State.

In digging a salt well at Liverpool, three miles north of Syracuse, fibrous gypsum was found twelve feet below the surface, in strata of black mud intermixed with slate; both above and below the strata, was found soft red rock, or indurated clay, full of seams, through which the salt water passes.*

Simeon Ford, Esq. for several years engineer of the pump-works at Salina, in describing the well which had been sunk in the marsh by the Syracuse and Onondaga Salt Company, says, "the strata of earth, to the depth of thirty-four feet, consisted of hard-pan and chocolate colored clay, intermixed with thin layers of sand. In the clay were found embedded stones of different sizes, from half a pound to half a hundred in weight, consisting of granite, quartz, red and white sand-stone, gray and blue lime-stone, sulphate of lime and slate, together with pieces of fine potter's clay."†

In another part of this communication, Mr. Ford states, that "salt water is found flowing in small veins on the marsh, the whole distance round the south end of the lake, from Liverpool to the mouth of Nine-mile creek, a distance of nine miles. In any part of the marsh for that distance, by digging down two feet, salt water will be found, though of very inferior quality, and will rise above the ordinary level of the lake at low water. The marsh is composed of a stratum of common shell marl; passing through the marl, the next stratum is hard-pan, and next chocolate colored clay. In the hard-pan and clay, small veins of salt are found, some rising perpendicularly and others running in horizontal lines. A horizontal vein of salt water enters the well now used, about two feet from the bottom, five inches in diameter. Through this, a stream is constantly pouring into the well; the coating of the vein appears to be sulphate of lime, and forms a perfect tube for conducting the salt water."‡

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* Silliman's Journal, XVI. 377.
† Legislative Documents, February 3d, 1826.
‡ Ibid.

The description here given agrees generally with the section of the boring of the Geddes well, a hundred and seventy feet below the level of the Onondaga lake. A copy of this section was furnished to me by Mr. J. J. Rice, who conducted the work, under the direction of Judge Earll, in 1831. The red and blue marly clay alternated at various depths, and the brine increased in strength from 11° to 48°, by an instrument on which the point of saturation was at 60°.

I might add to the above, the description of the strata passed through in boring for brine at Montezuma, in Cayuga county,* where these various colored clays, conglomerates and gypseous veins, were also observed; but their close resemblance to the strata near Salina and Syracuse renders it unnecessary. And it may be as well to state here, that all the clays around Salina and Syracuse contain large proportions of carbonate of lime. In one specimen from the vicinity of Syracuse, I found,

Carbonates of lime and magnesia, ...	89 grs.
Silica and alumina colored by oxide of iron, ..	11 grs.
With minute proportions of the chlorides of sodium and calcium,	—
	100 grs.

They therefore all belong to the class of marly clays, which are so constantly associated with fossil salt.

Having noticed the striking similarity in the formations near the Onondaga springs to those of many localities of fossil salt, I must also advert to a fact which by many persons is thought greatly to favor the theory now under consideration. It is, that the strength of the brine is influenced by the height of water in the Onondaga lake. Thus it is asserted, that in the early part of the summer, when the water in the lake is high, the brine contains a much larger amount of saline matter than at any other time. Dr. Wright, the superintendent of the salt works, informed me, that during the spring of 1836, when the water in the lake attained an unusual height, the brine at the Salina well had a density of 79° by an instrument on which the point of saturation was 100°; whereas ordinarily it does not exceed 63° or 64°. This extraordinary density continued only a short time; but a density of 70° is said to be no unusual occurrence under such circumstances. The increased strength of the brine in the early part of the season is supposed to be accounted for by the fact, that as the quantity of water discharged from the pumps during the winter is comparatively small, the brine continues for a longer time in contact with the fossil salt, and becomes more strongly impregnated with it. And again, when the quantity of water in the lake is large, the increased pressure upon the river of brine below, causes the stronger solution to rise higher in the well than at other times.

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* For a description of the strata at Montezuma, see Mr. T. A. Conrad's Report for 1837.

We have here a singular illustration of the manner which the same general fact is employed to strengthen theories directly opposite. Dr. S. P. Hildreth, in a paper on the bituminous coal deposits in the valley of the Ohio, &c. thinks the opinion that the brine springs in the valley of the Ohio are not supplied from a deposit of rock salt, but from salt in small grains or particles pretty equally diffused, strongly confirmed by the fact that the brine becomes weaker in a well worked very constantly, and the necessity of boring deeper to renew the strength of the water:—For, says he, "if the water was supplied from a deposit of pure solid salt, the well would remain of uniform strength. Another proof is found in the fact, that the *deeper* wells are supplied with a stronger water, showing that the further the saline strata are penetrated, the more certain they are to yield a strong brine."*

The fact just stated, viz. that the strength of the brine increases with the depth of the well, applies also to the Onondaga springs, and I should have offered it, among others, in favor of the theory that they have their origin in fossil salt: for, if I am not mistaken, at every locality of this mineral, the brine increases in strength, from the surface until it is in immediate contact with the bed from which it derives its saline impregnation. Nor does there seem to me to be any thing in the fact that the strength of these brines diminishes on being worked, which is at all inconsistent with this view.

I cannot omit the present opportunity of suggesting as a matter of great interest, and which may lead to important practical results, that a series of observations be made at regular intervals, upon the strength of the brine in the different wells on the margin of the Onondaga lake. If a set of standard instruments were to be procured, and the observations entrusted to the superintendent and inspector, we should soon have a collection of facts which would probably enable us to determine the true nature of these springs.

In connexion with the inquiry into the origin of these brine springs, it deserves to be stated, that funnel-form cavities of various dimensions are observed every where on the high grounds which constitute the boundary of the Onondaga lake. Some of these have been formed at a very remote period, as is evident from the size of the trees found in them.

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* Silliman's Journal, XXIX. 1.

Others are of more recent origin, and present the appearance of deep and perfectly regular wells, or excavations. Dr. Benjamin DeWitt, in a Memoir on the Onondaga Salt Springs, states, "that at a distance of half a mile from the Salt Point (Salina) there is a pit lately sunk into the earth; it is four or five feet wide, descends twenty feet perpendicularly, and then appears to take an oblique direction downwards." "This," he adds, "is supposed by some to have been caused by a vacuity underneath, produced by the solution of a body of salt in the waters which lead to the springs."*

I was so fortunate as to have the opportunity of examining a cavity of a similar kind, formed during the latter part of the month of May, 1837. It is on the grounds of Major Burnet, a short distance from the courthouse, about half way between the villages of Salina and Syracuse. The cavity, at the time when I visited it, was fifteen or sixteen feet deep, and about ten or twelve feet in diameter, and had a roundish or oval outline. The sides of this pit or well were perfectly smooth, and it had the appearance of a work of art. At the depth of ten or twelve feet, there was a stratum of reddish indurated clay, which had been broken off and carried in an oblique direction downwards, thus agreeing very well with the description given of a similar cavity by Dr. DeWitt. Upon subjecting to analysis a portion of this clay, I found it to be composed, as already stated, of carbonates of lime and magnesia, alumina, silica and oxide of iron—together with minute portions of common salt and chloride of calcium.

Although the formation of these cavities, or *sink holes*, in the immediate vicinity of the brine springs, seems to admit of a very easy explanation upon the supposition that beds of fossil salt exist at considerable depths below the surface, and that by the washing away of some blocks of it, a vacuity is produced, and the strata of earth, clay and rock thereupon subside, I was not prepared to receive it, until I found notices of similar occurrences near the beds of rock salt in Cheshire† and Worcestershire, in England. Dr. Hastings, in the account of the salt springs of Worcestershire, already quoted, states the following fact with regard to the discovery of rock salt at Stoke Prior. Without the least apparent indication of the existence of this mineral, it seems that one of those persons called brine smellers, pronounced that there was salt in that vicinity.

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* Transactions of the Society of Arts, &c. of the State of New-York, I. 268 (1801.)

† See Holland's survey of Cheshire, page 20.

"As to the rule," says our author, "by which the said Cheshire brine smeller determined that there was salt at Stoke Prior, I know nothing; but he attached great importance to what he called brine slips. By brine slips it appears that he meant a sudden slipping of the red marl which sometimes occurs about Droitwich. It not very uncommonly happens in this district, that on a sudden, a chasm will be formed twenty or thirty feet long, and a foot wide, by the giving way of the ground. These chasms are of great depth, and it is supposed by many persons that they communicate with salt strata below. Whether this be true or not, it is certain that the Cheshire salter assured his Worcestershire friends that he smelt the salt at these chasms, and hence inferred that the work of mining might be attempted with security. He probably drew his inference, not from the sense of smell, but from the appearance of the marl. The result has at any rate proved him right in his prognostication, for solid rock salt was here for the first time found in Worcestershire."*

I take pleasure in stating that the views which I have been led to adopt concerning the origin of these brine springs, are supported by the observations of professor W. B. Rogers, who has recently examined the salt springs of Virginia. "At the salt works on the Holston," says he, "the wells are usually from 200 to 300 feet in depth, presenting strata of limestone near the surface, sandstone or slate alternating with beds of gypsum several feet in thickness, next beneath, and finally a stratum of clay within which the salt water is procured. This clay is of a reddish aspect, and a very argillaceous texture, being in all probability a softened shale, such as that of the brine springs and rock salt of Cheshire, in England. In fact, a marked analogy is presented in the structure of the salt region of the Holston and that of Cheshire. In the latter, beds of gypsum are found alternating with strata of indurated clays and sands, approaching to slates and sandstones; and carbonate of lime exists largely in the strata lying near the surface. In all these particulars the salt region of the Holston corresponds with it very closely.

"The great value of the Cheshire region, however, results from the heavy beds of rock salt which it includes, and of the existence of such upon the Holston, though far from improbable, no positive testimony has as yet been obtained.

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* The occurrence in the vicinity of Salina and Syracuse, of weak brine springs impregnated with sulphuretted hydrogen, is another point of resemblance between this region and that in Worcestershire, (England,) where fossil salt occurs, which is particularly worthy of notice. A description of these springs will be found in a subsequent part of this report.

" The curious fact, that on some occasions granules or small crystals of salt are brought up by the water of the wells, is certainly very much in favor of the opinion, that such beds of massive salt do actually exist, at depths to which the borings hitherto made have not been extended, and furnishes strong additional incentives to a persevering and thorough exploration, by boring in numerous places, penetrating to still greater depths."*

On the whole, therefore, the probabilities are greatly in favor of the theory which attributes the origin of the Onondaga brine springs to beds of massive or fossil salt—because the strata in the vicinity are exactly similar to those which are found near the deposits of fossil salt in foreign countries; the brine in all the wells increases in strength with the increase in their depth; the soil in the vicinity is subject to those peculiar slips or sinkings which have also been observed in the vicinity of beds of rock salt; and finally, because it is not open to many of those serious objections which may be urged against the other theories.

Whether the opinion here asserted to be the most consistent with the facts now known, will ultimately be confirmed or not, the importance of deeper borings than have hitherto been made in our principal salt district, cannot be too strongly urged. If the only thing gained by such an undertaking should be a stronger brine than that now furnished by the wells, the saving in fuel alone, and the consequent increase in the quantity of salt manufactured, would in a few years amount to a sum fully equal to that expended in the work. A boring of five or six hundred feet, at a point properly selected, would probably decide the question in regard to the existence of fossil salt, or furnish brine of the maximum strength.

Brine Springs of Onondaga County.

The fact that the State derives an important part of her revenue from these springs, and that they furnish employment and give support to many thousands of her citizens, seems to render it necessary that I should present a detailed description of them; and also that I should offer such suggestions concerning the manufacture of salt, as may be thought worthy of attention.

It is well known that the principal brine springs in this county cluster around the margin of Onondaga lake, a fine sheet of water about six miles in length and one mile in width. The water of this lake is not as has been stated, salt at the bottom, but is fresh throughout.* The salt water found every where on the marsh which forms the boundary of the lake, is prevented from communicating with the fresh water by a bed of marl, from three to twelve feet in thickness, below which is a stratum of marly clay.

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* Report of a Reconnoissance of the State of Virginia: by Prof. W. B. Rogers. 1836.

There are at present on the marsh surrounding this lake, four wells and pump works for the raising and distributing of brine, under the direction of the State authorities, viz: one at Salina, another at Syracuse, a third at the village of Geddes, aud a fourth, recently completed, on the Oswego canal, near the village of Liverpool.

Salina Well.—The well at Salina, which was opened twelve or thirteen years since, is seventy feet in depth, and from it, brine is raised by means of forcing pumps to a reservoir sufficiently high and capacious to supply the salt works at this village, and occasionally also those at Syracuse and Liverpool. In consequence either of the greater power of the machinery, or the more abundant supply of brine, this well affords a larger quantity than any, or indeed than all of the others. According to observations made about the middle of July last, the pumps at Salina raised four hundred and eighty-two gallons of brine in a minute, or twenty-eight thousand, nine hundred and twenty gallons in an hour.

The temperature of the Salina brine during its passage from the pumps into the reservoir is 50° F., which is probably very near the temperature at its source. The brine is perfectly limpid, and has a somewhat sparkling appearance, owing to the escape of a small quantity of carbonic acid which it contains, and which holds in solution a minute portion of the carbonates of lime and of iron.

Nutgalls and ferro-cyanate of potash, when added to the brine recently drawn, exhibit the changes of color which are due to the presence of a salt of iron; but they have not the least effect upon the brine after it has been exposed for a few hours to the air. Indeed, even when kept in a well corked bottle for eighteen hours, these tests produced scarcely any effect. This is owing to the fact that the iron exists in the form of carbonate, and is held in solution by an excess of carbonic acid, and in this state causes the changes of color which are produced when the proper tests are added; but when this excess of carbonic acid escapes, as it does by the exposure of the brine to the air, the oxide of iron falls down in reddish flocks, and the tests then produce no effect.

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* In the paper on these springs, to which reference has already been made, I stated that the water of Onondaga lake was salt at the bottom, on the authority of Dr. B. De Witt. It now, however, appears, from the repeated observations and experiments of Judge Ford and others that this is not the case.

The specific gravity of this brine is 1.11060 at 60° F. And as has already been stated from the information which we possess on this point, it is highly probable that for a period of at least thirty-six years, its strength has suffered little or no change. I cannot but hope that we shall hereafter have a set of observations which will enable as to determine with more accuracy than is at present possible, whether the strength of the brine is subject to periodical variations, and whether it is or is not influenced by the state of the atmosphere.

1,000 grains of the Salina brine evaporated to perfect dryness by the application of a sufficient degree of heat, left a residuum of 146.50 grains. According to an analysis which I have recently made, the following is the composition:

Carbonate of lime,	0.17
Sulphate of lime,	4.72
Chloride of calcium,	1.04
Chloride of magnesium,	0.51
Chloride of sodium, or common salt,	140.02
Oxide of iron, with a minute portion of silica and carbonate of lime,	0.04
Carbonic acid, holding in solution the carbonate of lime and oxide of iron,	0.09
Water, with a trace of organic matter, and bromine,	853.41
	1000.00

This brine contains 1130 grains of pure and perfectly dry chloride of sodium in a wine pint, and 9045 grains or 1.29 lbs. avoirdupois, in a gallon. It therefore requires forty-three and a half of these gallons to yield a bushel of salt weighing fifty-six pounds. But as salt made by boiling, ordinarily contains not less than five per cent of water, forty-one and a half of these gallons will yield a bushel of salt of merchantable quality.

Syracuse Well.—This is situated on the marsh, near the coarse salt fields. The well is about one hundred and seventy feet in depth and supplies with brine the salt works at Syracuse.

According to the observations of Dr. Wright and myself, the pump at the Syracuse well raises and distributes sixty-two gallons of brine in a minute, although this was thought to be below what it usually accomplishes. The temperature of the brine as it passes from the tube into the reservoir, is 51° F. It has the same sparkling appearance as the Salina brine, and when recently drawn behaves with the tests of iron in a similar way, except that the changes of color are not so rapidly produced.

The specific gravity of brine taken from the Syracuse well on the 21st of September,* was 1.10499 at 60° F. The amount of dry solid matter in 1000 grains of the same brine, is 139.53 grs. The following are the results of my analysis.

Carbonate of lime,	0.14
Sulphate of lime,	5.69
Chloride of calcium,	0.83
Chloride of magnesium,	0.46
Chloride of sodium or common salt,	132.39
Oxide of iron, with a minute portion of silica and carbonate of lime,	0.02
Carbonic acid, holding in solution carbonate of lime and oxide of iron,	0.07
Water, with a trace of organic matter and bromine,	860.40
	1000.00

There are 1063 grains of dry chloride of sodium in a wine pint of this brine, and 8506 grains, or 1.21 lbs. avoird. in a gallon: and it requires forty-six and a quarter of these gallons for a bushel of perfectly dry salt, or about forty-four gallons for a bushel in its ordinary state.

Geddes Wells.—There are two wells at this village: The one nearest the lake, is a hundred and twenty-four feet below its level; the other is near the pump house, and is a hundred and seventy-six feet below the level of the lake.

The temperature of this brine is exactly the same as that of the Syracuse well; it has the same appearance, but the tests of iron produce a more marked effect than upon either of the former. Its specific gravity is 1.10601. The pump at this place raises about a hundred gallons of brine in a minute.

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* I have reason to believe that the strength of this brine varies considerably during the season. On the 13th of June, 1837, the specific gravity was found to be 1.10978, while at the same time the specific gravity of the Salina brine was 1.10884, showing that the former contained more saline matter than the latter. The brine taken from each of the wells on the 21st of September, had a specific gravity for the Salina brine of 1.11060, and for the Syracuse, of 1.10499; showing that the former had increased in strength by the three months' pumping, while the latter had become weaker. Whether these results are owing to a difference in the situation of the two wells, or in their construction and management, I am not at present prepared to say. I found a slight diminution also in the strength of the Geddes brine during the same period.

1000 grains of the brine from the Geddes well yielded upon evaporation 138.55 dry solid matter. The composition of the whole is as follows:

Carbonate of lime,……	0.10
Sulphate of lime,……	4.93
Chloride of calcium,……	2.03
Chloride of magnesium,……	0.79
Chloride of sodium or common salt,……	130.66
Oxide of iron, with a minute portion of silica and carbonate of lime,……	0.04
Carbonic acid, holding in solution the carbonate of lime and oxide of iron,……	0.06
Water, with a trace of organic matter and bromine,……	861.39
	1000.00

If the above analysis is correct there are 1051 grains of dry chloride of sodium in a wine pint of this brine, and 8408 grains, or 1.20 lbs. avoird. in a gallon, and it requires about forty-six and a half gallons for a bushel of dry salt, or about forty-four gallons for a bushel of salt in its ordinary state.

Liverpool Well.—This well is near the village of Liverpool, twenty-five rods from the Oswego canal and fifty rods from the bold shore of Onondaga lake. In boring this well the strata passed through were as follows, viz: From the surface twelve feet, principally marl, similar to that found in the bed of the lake, the shells being mostly broken up and decayed. Next to the marl, was fourteen feet of fine sand; and below this forty-three feet of a very fine clay of a greyish colour. Below this clay, to the depth of eighty-one feet from the beach at low water, was a bed of gravel made up of pebbles of various sizes with some sand. The brine was first observed in the gravel, although the clay above it had a brackish taste.

The pump which has recently been put into operation at this well, raises a hundred and two gallons of brine in a minute. This brine, it needs scarcely to be added, closely resembles that from the other wells, but its specific gravity is higher, being 1.11467. It is the strongest brine that has hitherto been obtained in this State. 1000 grains yielded 149.54 grs. dry solid matter. The following are the results of my analysis.

Carbonate of lime,	0.13
Sulphate of lime,	4.04
Chloride of calcium,	1.72
Chloride of magnesium,	0.77
Chloride of sodium, or common salt,	142.85
Oxide of iron, with a minute portion of silica and carbonate of lime,	0.03
Carbonic acid, holding in solution carbonate of lime and oxide of iron,	0.07
Water, with a trace of organic matter and bromine,	850.39
	1000.00

There are therefore 1,154 grains of pure chloride of sodium in a pint of this brine, and 9236 grs. or 1.32 lbs. avoird. in a gallon. Hence, forty-two and a half gallons will yield a bushel of perfectly dry salt, or about forty and a half gallons for a bushel, in the ordinary state of dryness.

Present state, and prospects of the manufacture of salt at the Onondaga springs.

Under this head, my object is to present a few facts intended to exhibit the advantages which the Onondaga springs possess, and to offer some suggestions concerning the modes of manufacture pursued at the works in their vicinity.

According to a report of the Secretary of the Treasury made in 1830, the quantity of salt manufactured in the United States in 1829, was 3,804,229 bushels, of which the Onondaga springs furnished 1,291,220 bushels. The amount of salt made at these springs, however, has increased considerably since the date of that report, and in 1835 amounted to 2,222,694 bushels. Admitting that the produce of the other works in the United States has increased in the same ratio, the Onondaga springs still yield more than a fourth part of all the salt manufactured in this country.

If our estimate of the amount of brine raised by the pumps now in operation, at Syracuse, Salina, Liverpool and Geddes, be correct, we have a total of 44,760 gallons in an hour, or 1,074,240 gallons in twenty-four hours. If the same amount was raised for three hundred days, it would give a total of 322,272,000 gallons of brine, which, allowing fifty gallons of brine to a bushel of salt, would yield 6,445,400 bushels. This allowance I think is sufficient to cover all unavoidable loss in the manufacture, as it appears from the analyses that have been given, that in all the brines forty-five gallons actually contain a bushel of common salt, in its ordinary state of purity.

The following statement will show that heretofore there has been a great waste of brine. During the year 1836, the three pump-works were in operation at Salina, Syracuse and Geddes, at least two hundred and fifty days. During this period there were raised not less than 230,000,000 of gallons of brine, while the amount of salt made during that year fell short of 2,000,000 bushels. At least 100,000,000 of gallons of brine, therefore, were lost; and although this may seem to be a matter of small moment, it will, when properly considered, be found of some importance. The State, it is true, is more interested in it than the manufacturers, for on account of this waste the expense of supplying the brine is greatly increased.

The great waste of brine, rendered evident by the above statements, has been in part owing to the distance to which it has been carried. Thus, the salt works at Liverpool were, until the present season, supplied with brine from the Salina well, conducted through wooden tubes for nearly three miles; and the Syracuse works were also for many years supplied from the same source. There must have been, therefore, a considerable loss of brine from leakage. But this waste is undoubtedly in a great measure owing to the faulty construction and management of the reservoirs by which the individual works are furnished with brine.

As the success of the manufacture of salt depends upon the strength of the brine, price of fuel, &c. a few facts upon these points may not be uninteresting; especially as it is feared by many persons that the abundant supply of coal found near some of the salt springs in other States will have an unfavorable effect upon our works.

The following table will exhibit the relative strength of the different brines from which salt is manufactured in the United States:

At Nantucket,	350	gallons sea water give	a bushel of salt.
Boon's Lick, (Missouri,)	450	gallons brine, give	do
Conemaugh, (Penn.,) ..	300	do	do
Shawneetown, (Illinois,)	280	do	do
Jackson, (Ohio,)	213	do	do
Lockharts, (Miss.)......	180	do	do
Shawneetown, (2d Saline,)	123	do	do
St. Catharines, (U. C.) ..	120	do	do
Zanesville, (Ohio,)......	95	do	do
Kenawha, (Va.)........	75	do	do

Grand River, (Arkansas,)	80 gallons brine give one bushel salt	
Illinois River, do	80 do	do
Muskingum, (Ohio,)	50 do	do
Onondaga,* (N. Y.)	41 to 45 do	do

Professor Rogers thinks that some of the brine wells on the Holston, in Virginia, contain about twenty per cent of saline matter; which if the impurities are not in larger proportions than usual, must be stronger than any yet found in this country. But it may be remarked that the mode by which he arrives at this result is not sufficiently accurate.

With the above exception, however, the Onondaga brines are the strongest of all the American varieties. But there are still some considerations which should be taken into the account in estimating the relative value of these brines. Thus the Kenawha brine is said not to contain any sulphate of lime, and hence the process of obtaining the salt in a pure crystalline form is attended with fewer difficulties than usual. Another great advantage possessed at these salines is that coal may be obtained at comparatively little cost from the hills adjacent to the salt furnaces; and their importance may be judged of by the fact that about 3,000,000 bushels of salt are now annually made from them.†

Some important reflections crowd upon us as New-Yorkers, from a review of the facts just stated. As it is not probable that coal will be found in the vicinity of our principal salt works, and as wood for fuel must gradually increase in price on account of the wanton destruction of our forests, every suggestion for economising its consumption, is deserving of careful examination.

It is evident that there would be a great saving in this respect, if by deeper borings a more highly concentrated brine could be obtained. A brine containing twenty-six per cent of saline matter, like that of Nortwich, in England, would of course require much less fuel for its manufacture into salt than one which contains only fourteen or fifteen per cent, which is the maximum of saline matter afforded by any of our brines.

If however this desirable end cannot be attained, other expedients may be resorted to with a reasonable prospect of advantage. Among these I would mention the partial evaporation of the raw brine by causing it to fall in small streams through faggots of wood arranged across each other, or through a collection of ropes stretched perpendicularly. By these arrangements the brine is divided, and presenting a larger surface, evaporation is facilitated, and the brine collected in the vessels below is much stronger than that which was pumped up. This contrivance is extensively adopted in Lombardy, Saxony, Bavaria and France.* To show the advantage which may be gained in this way, it may be stated that sea water has its density increased from 1.010 to about 1.140. Such an increase of strength would be sufficient to bring the Salina brine nearly to the point of saturation.

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* This table is chiefly extracted from Dr. J. Van Rensselaer's Essay on Salt. The produce of the Kenawha brine, and of the Muskingum saline is added from Hildreth's observations on the saliferous rock formation in the valley of the Ohio. Silliman's Journal XXIV, 65.

† Professor W. B. Rogers' Report of the Geological Reconnoisance of Virginia, 1836, p. 123.

If some apparatus of the kind now noticed, could be constructed by the State at its different reservoirs, and the concentrated brine distributed to the various salt works, it is scarcely possible to estimate the advantage which would result from it.

Although great improvements have recently been made in every part of the manufacture of salt at the Onondaga works, some points are still worthy of notice, and especially the construction of the reservoirs attached to the individual furnaces. These reservoirs are intended to effect the precipitation of some of the impurities of the brine either by the simple exposure of it to the air, or by the addition of some foreign substance which shall facilitate the desired separation. As a free exposure to the atmosphere favors the concentration of the brine and consequently the deposition of these impurities, it is obvious that these reservoirs should be as large as possible, and should be provided with covers which may be used during rainy weather, and thus prevent the large admixture of fresh water, which is otherwise unavoidable.

It is a very common practice at the Onondaga works to add lime to the brine contained in the reservoirs, and the same substance is also sometimes thrown into the kettles during the boiling of the salt. This point among others, was particularly examined by a committee of the Legislature in 1825; and I have found no reason to change the opinion which I expressed at that time, viz. that the addition of lime, if properly made, expedites the process of manufacture and does not in the least impair the purity of the salt. I should observe, however, that the advantage gained by the use of lime depends upon its purity, and upon the time allowed for its precipitation, before the *salting* commences. When added to the salt during the boiling, it impairs its purity and may be a fraudulent operation, unless great care is taken in again removing it by the pans with which the kettles are supplied.

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* For a particular description of apparatus, &c., see Dumas. Chimie appliquée aux arts. Professor Mather has made a similar suggestion for the concentration of sea water on our coast. Geological Report for 1837.

The correctness of these views will be evident, upon a recurrence to the changes which the addition of lime causes in the composition of the brine. The excess of carbonic acid which holds in solution the carbonate of lime and oxide of iron in the raw brine, combines with the added lime, and causes a deposit of the whole insoluble carbonate. Moreover, the lime decomposes the chloride of magnesium, and there result chloride of calcium held in solution, and magnesia precipitated. The chloride of calcium thus formed, as well as the amount originally contained in the brine, may be further decomposed by the employment of sulphate of soda, which produces sulphate of lime, presently thrown down, and leaves the salt in a nearly pure form. And if this salt, the sulphate of soda, could be obtained at as cheap a rate as it is in some parts of the world, it could no doubt be advantageously employed for this purpose.

It seems to me, therefore, that there can be no good objection to the use of lime if it be confined to the reservoirs, as it causes the more speedy separation of the earthy matters, and renders the subsequent salting more rapid and perfect. But I would repeat, that in order to secure its beneficial effect, the lime should be in as caustic or pure a state as it can be conveniently obtained. Lime which has been air slacked, or which has been previously used in a similar operation, cannot be advantageously employed: indeed it answers no better purpose than so much sand or clay. And with regard to the addition of this substance to the brine while boiling, I can only say, that if the resulting earthy matters be carefully removed, its use may be tolerated; but it cannot be concealed, that in such cases there is a strong temptation to hurry the process to completion, and thus to mix up the earthy ingredients with the salt.

All these difficulties are avoided in the mode of manufacturing salt by solar evaporation, and by the application of a moderate degree of heat to large shallow pans containing purified brine. In the former case the impurities subside in separate vats, after which the brine, thus purified, is drawn off into another tier of vats in which the crystallization of the salt takes place. This salt is in large, hard and white crystals which suffer little change by exposure to the air: it is the purest salt that can be manufactured, as will be seen by inspecting the table of the composition of different varieties herewith presented.

There are various modes of applying artificial heat in the manufacture of salt, other than that employed in the ordinary process of boiling in kettles. In one arrangement, tubes heated by steam pass through a vat or vats of considerable extent, the brine having previously been freed from its insoluble impurities, by being allowed to remain for some time in the cistern, or by the addition of lime. This furnishes salt in fine cubic crystals of great purity, especially in those parts of the vats which are at some distance from the immediate source of heat. The works of Dr. Green, at Salina, are arranged in this manner, and are especially deserving of notice, on account of the neatness which is every where observable, and the economy with which the different steps of the manufacture are conducted.

Great improvements have been made within a few years in the *blocks*, or furnaces, at the Onondaga springs, in which by far the largest proportion of salt is still manufactured. These have not only been much increased in size, but the heat is at present much more advantageously applied. Instead of the twelve or fourteen kettles, which fifteen years since was the usual number, they are now supplied with from thirty-two to forty.

In concluding this notice of the brine springs of Onondaga county, I feel it my duty to acknowledge the many obligations I am under to Dr. Wright, the superintendent, and to Judge Allen, the inspector, at these works, for the assistance which they constantly afforded me in my examination of this interesting region. I am also indebted to several gentlemen of Syracuse for much valuable information, and many gratifying civilities. And I cannot omit the present opportunity of adverting to the many advantages possessed by the district which contains these springs, and to the manner in which they have been improved. Situated on the banks of the great Erie and Oswego canals, the exhaustless treasures which these brine springs afford, can be easily transported to the east, west and north, and can be carried at a comparatively cheap rate to every part of the northern States. In addition to this, Syracuse, which is now by common consent admitted to be the centre of the salt region, forms the termination of the rail-road from the Split Rock stone quarries, where limestone of the best quality for the construction of locks and aqueducts is obtained in enormous quantity, and some of the strata of which afford the beautiful bird's eye marble, susceptible of a fine polish, and much admired for mantle and other ornaments. It is, moreover, the termination of the Auburn and Syracuse rail-road, which will contribute greatly to the prosperity of both these flourishing villages. The hills through which this road passes contain inexhaustible supplies of gypsum and limestone for lime, of the former of which more than forty thousand tons have already been raised, and are now ready for transportation. And throughout the whole of the region bordering on the Onondaga lake, beds of marl are almost too numerous to be particularly designated.

I have only to add to the suggestions already made, that several manufactures in which common salt is employed, may be advantageously carried on in the vicinity of these springs; such as those of soda, ash, or British barilla, the various preparations of soda for medicine, chloride of lime, &c.

For the purpose of determining the relative purity of various kinds of salt, I have subjected them to analysis, and the results are as follows:

TABLE

Showing the composition of various specimens of Onondaga and foreign salt, in 1000 parts.*

KINDS OF SALT.	Carbonates of lime and magnesia.	Sulphate of lime.	Sulphate of soda.	Chlorides of calcium and magnesium.	Pure chloride of sodium.	Total.
1. Salt made by solar evaporation, at Syracuse,	....	7.00	....	2.00	991.00	1000
2. do do Geddes, by Mr. Brewster,	1.00	6.50	....	Trace.	992.50	1000
3. Table salt, prepared and put up by A. Woodruff, Salina, N. Y.	0.20	6.61	....	1.46	991.73	1000
4. Salt, labelled 'extra good,' made by Buel & Foot, Salina,	0.38	5.78	....	3.50	990.44	1000
5. Salt made by boiling saturated brine, at the works of Dr. Green, Salina,	....	8.92	....	1.64	989.44	1000
6. Salt made by slow evaporation, Syracuse, Mr. Byington,	....	9.00	....	2.50	988.50	1000
7. Salt made by boiling, at Salina,	0.40	20.09	....	3.26	976.25	1000
8. Salt condemned, at Salina,	4.32	14.88	....	6.36	974.44	1000
9. Salt do do	5.52	17.51	....	....	976.97	1000
10. Turks Island salt,	2.80	13.16†	....	....	984.04	1000
11. Liverpool fine salt,	0.23	8.77	2.01	....	988.99	1000

*All the specimens, previously to the analysis, were brought to a state of perfect dryness, by a heat of 400° or 500°. The loss in weight was from one half to twelve per cent. In both the specimens labelled "condemned salt," the proportion of water was very great. It was probably the imperfect manner in which the drying process was performed, rather than the amount of saline impurities which they contained, that subjected them to the condemnation of the inspector.

† And sulphate of Magnesia.

Montezuma Brine Springs.

The brine springs at Montezuma were discovered at a very early period by the Indians, and were shown by them to the first white settlers. The brine was originally obtained by digging small holes in the ground a foot or two in depth, in the marsh at the foot of the ridge upon which the village of Montezuma is situated. Subsequently, wells were sunk by the whites, to the depth of forty or fifty feet, from which brine was obtained in sufficient quantity for the manufacture of salt.

In 1807, salt water was discovered in a branch of the Seneca river, since called Salt creek, at the depth of eight or ten feet from the surface. The brine thus obtained was similar in quality to that in the wells already noticed. In 1810, under the direction of the Cayuga Manufacturing Company, a well was sunk about a hundred feet deep, on the west side of the ridge upon which the village now stands. In sinking this well, three separate springs of water were discovered. The first was about ten feet from the surface, and was like that which had been previously used. Then succeeded a stratum of fine blue clay, five or six feet in depth. Below this was a stratum of hard-pan, with occasionally some gravel, about thirty-five feet in depth. A third stratum of quicksand succeeded, in which was found some weak brine, yielding about ten ounces of saline matter to the gallon. Lastly, there were strata of sand and clay, with some water, to the depth of one hundred feet, where was found the great fountain of brine, which came in through a body of quicksand. This brine when unmixed with that of the upper veins is said to have produced twenty ounces of saline matter to the gallon.*

A year or two afterwards, another well was sunk, on the east side of the ridge, and the great fountain of brine was found at the depth of eighty feet. The strata passed through were similar to those in the preceding well. The *New Well,* more recently opened, (I believe in 1824) is a hundred and twenty feet deep. At a hundred and fifteen feet, the brine was said to have been of sufficient strength to yield eighteen ounces of saline matter to the gallon. On reaching the quicksand, however, the brine rose rapidly, and in two or three days overflowed the top of the well.

Here, as at the Onondaga springs, the opinion is quite generally maintained, that the brine has its origin in beds of fossil salt, and many facts are stated which are thought to confirm this view. Most of these, how-

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[*] See a Letter from Comfort Tyler, Esq. published in the Appendix to Dr. Van Rensselaer's Essay on Salt. Mr. Tyler was one of the first settlers of this county.

ever, have already been noticed in the remarks which have been offered upon this point.

In 1823, the salt made at the Montezuma springs amounted to between sixteen and twenty thousand bushels, of which about a thousand were procured by solar evaporation. Since that time, the annual produce has gradually decreased, until at present it does not exceed a few hundred bushels.

This great depression of the manufacture is owing to several circumstances. One of these undoubtedly is the rudeness of the pump-works. The brine is raised by hand or horse power, and the tubes are so imperfectly constructed, that fresh water is continually flowing in and reducing its strength. The soil is moreover owned by individuals, and the manufacturer is obliged to purchase or lease it, as well as to erect his works. At the Onondaga springs, on the contrary, grounds are furnished by the State without charge.

Again, the inferior strength of the Montezuma brine has operated unfavorably upon the manufacture at this place. On the other hand, the advantages possessed here, are an abundant supply of wood, and eligible sites for the erection of works on a side cut from the Erie canal. And it seems to be reasonable and proper that the State should erect pump-works at these springs, as she has at those of Onondaga. The importance of this suggestion will be evident from the fact which I have on the authority of an intelligent gentleman of Montezuma, that the cost of raising brine by the rude machinery which they are now obliged to use, is not less than six cents a bushel. If a good well should be sunk here, and pump works erected under the direction of the State, as at Salina, Syracuse, &c. a new stimulus would be given to the manufacture of salt at these springs. Such an arrangement would add to the revenue of the State, while it could in no way interfere with the manufacture at the Onondaga springs. With these views, I beg leave to present this subject to the notice of those who are entrusted with the management of this important concern.

Analysis of the Montezuma brine.

Specific gravity 1.07543. 1000 parts of the brine yield 101.20 dry solid matter. The composition of the whole is as follows:

Carbonate of lime,	0.18
Sulphate of lime,	5.25
Chloride of calcium,	1.40
Chloride of magnesium,	1.00
Chloride of sodium, or common salt,	93.35
Oxide of iron, with a minute portion of silica and carbonate of lime,	0.02
Carbonic acid, holding in solution the carbonate of lime and oxide of iron,	0.08
Water, with a trace of organic matter,	898.72
	1000.00

This brine, therefore, contains 700 grains of dry chloride of sodium in a wine pint; 5600 grains, or 0.80 lb. in a gallon; and it requires nearly seventy gallons for a bushel of salt. The strength of the Geddes brine when compared to this, is about as ten to seven,—of the Liverpool brine, as ten to six and a half.

TABLE,

Showing the composition of various Brines, from Onondaga and Cayuga counties, N. Y.

LOCALITY OF THE WELL OR SPRING.	Total amount of solid matter, in 1000 grains of brine.	Carbonic acid.	Oxide of iron and silica, with a trace of carbonate of lime.	Carbonate of lime.	Sulphate of lime.	Chloride of magnesium.	Chloride of calcium.	Chloride of sodium, or pure common salt.	Water, with a trace of organic matter, &c.	Total.
ONONDAGA.										
From the well at Geddes, ...	138.55	0.06	0.04	0.10	4.93	0.79	2.03	130.66	861.39	1000
From the well at Syracuse, ...	139.53	0.07	0.02	0.14	5.69	0.46	0.83	132.39	860.40	1000
From the well at Salina, ...	146.50	0.09	0.04	0.17	4.72	0.51	1.04	140.02	853.41	1000
From the well at Liverpool,..........	149.54	0.07	0.03	0.13	4.04	0.77	1.72	142.85	850.39	1000
CAYUGA.										
From a well at Montezuma, ...	101.20	0.08	0.02	0.18	5.25	1.00	1.40	93.35	898.72	1000

GAS, OR CARBURETTED HYDROGEN, SPRINGS.

One of the most interesting facts connected with the history of mineral springs, is, that some of them constantly give out an inflammable gas, which on examination proves to be carburetted hydrogen, often in a state of great purity, but occasionally mixed with small portions of other gaseous bodies. This gas is also sometimes observed to issue from clefts in rocks; and the close resemblance of its flame to that of coal gas, seems at first sight to warrant the conclusion that it has its origin in the decomposition of coal. But this, however, is not in every case the true theory of its formation.

Carburetted hydrogen may be distinguished from sulphuretted hydrogen, the gas which gives character to what are called sulphureous or sulphuretted springs, by its not possessing that offensive odour, and by its not producing those changes in metallic solutions which are such marked properties of the latter gas.

Carburetted hydrogen may sometimes be obtained, mixed however with minute portions of carbonic acid and nitrogen gases, by agitating the bottom of a stagnant pool, especially if it is formed of clay. Its production under such circumstances is usually ascribed to the decomposition of vegetable matter. But this explanation is in some cases quite unsatisfactory.

A locality of the kind just noticed occurs in the town of Northeast, in the county of Dutchess, where from the bottom of a small lake proceeds inflammable gas of considerable purity. In a marsh in Chautauque county, to be presently described, the same gas, containing, however, some admixture of carbonic acid, is constantly rising through the water.

Albany Gas Spring.—Inflammable gas is quite abundantly evolved through a boring made into the slate in the city of Albany. Here it appears to be associated with the carbonated water; sulphuretted hydrogen, also, issues from the same boring, but its source is much above that of either of the former. That these gases are not connected with each other, and proceed from different strata, is proved by the fact, that upon sinking down a tube, the mineral water is obtained uncontaminated with either of these substances.

The gas which issues from the Albany spring burns with a white flame, tinged with red, and at length, when the flow of gas is temporarily impeded, the flame is of a blue colour, owing probably to the imperfect combustion. When a current of it is made to pass through a solution of acetate of lead, no change of colour ensues:—hence it cannot be mixed with sulphuretted hydrogen.

Oneida Gas Springs.—Carbonated hydrogen gas issues through a crag or gravelly soil about a mile west of the village of Vernon, in the county of Oneida. According to Prof. Eaton who made several trials in July 1823, it issues through a spring of water at the rate of a gallon in a minute; he states that he observed it "issuing from several small masses of water along the foot of the same hill; which naturally induced a belief that it rises from the earth in all parts of several acres of ground adjoining the chief spring. The underlying rocks are fields or patches of ferriferous rock, resting on the saliferous rock. The gas burns with a flame of a reddish white colour, and blue at the base."*

Ontario Gas Springs.—In Ontario county there are several places at which the same gas is evolved in considerable quantities. These inflammable springs, as they are called, are observed on both sides of Canandaigua Lake and within three miles of the village of the same name. But the most noted locality is in the town of Bristol, about nine miles W. S. W. from Canandaigua, and seventeen or eighteen miles south of the Erie Canal at Perrinton. It occurs in a ravine on the west side of the valley of Mud creek, which is here called Bristol Hollow. The sides of the ravine, as well as the borders of all the valleys in its vicinity, are formed of a blueish grey shale.

Dr. Hayes, from the experiments which he made upon this gas, concludes that it consists principally of the light and heavy carburetted hydrogen, and that it contains carbonic acid, but no sulphuretted hydrogen. Mixed with a small proportion of olefiant gas obtained from alcohol, and inflamed in a proper burner, it forms a brilliant gas light.

The same gentleman describes another locality still more remarkable on the south eastern side of a valley called Federal Hollow, one mile from Rushville and about twenty-one miles from the canal at Palmyra. "For a space extending along the valley, from northeast to southwest more than half a mile, and in some places more than a quarter of a mile in breadth, numerous springs of inflammable gas have appeared. In a field near the northeastern extremity of this tract, and at an elevation of forty or fifty feet from the bottom of the valley, several hillocks may be seen of a few inches in height, and from two or three to ten or twelve feet in diameter. They consist of black mould, and are destitute of vegetation; from these gas issues, and on digging into the earth beneath, may be obtained in considerable streams. These hillocks have appeared successively, within a period of seven or eight years, although the ground has been cleared much longer. The first indication of their formation is the disappearance of vegetation at a particular point; this is enlarged, the mould accumulates and the hillock is gradually formed. In very cold weather, the gas is said to issue from the tops of hollow cylinders of ice, sometimes two or three feet in height, forming when lighted in a still evening a beautiful illumination."*

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* Silliman's Journal, XV. 236.

Niagara Gas Springs.—In the town of Royalton, Niagara county, six and a half miles east of Lockport, carburetted hydrogen issues through the water of a basin on the south side of the Erie canal. This is said by Prof. Eaton not to have been observed until the water was let into the canal. Upon testing this gas, it was found to resemble that at Vernon, but it approached nearer to the character of light carburetted hydrogen. A large proportion of the flame is blue. The quantity which issued through the basin at one place exceeded a gallon a minute. This place was named *Gasport.*†

Chautauque Gas Springs.—By far the most interesting exhibitions of the evolution of carburetted hydrogen which occur in this State, are to be observed in the county of Chautauque. The village of Fredonia, indeed, has attracted much attention in consequence of the gas springs found in its immediate vicinity, although they are by no means confined to this particular locality.

The village of Fredonia is situated on the Canadawa creek, about three miles south of Lake Erie; and the gas springs seem to have their origin in the strata of slate which form the bed of the stream, and which are every where met with in this vicinity, a short distance from the surface of the earth. This slate has a blueish color, and some of the layers are exceedingly fragile, requiring only a few years exposure to be completely converted into a clayey soil. The lower strata, however, resist atmospheric agencies, and are sometimes used as a building material. When recently broken, this slate always emits a strong bituminous odour, and it frequently contains thin seams of a substance resembling bituminous coal. Most commonly, however, this bituminous matter occurs in patches, having more the appearance of detached vegetable impressions, than of a regular stratum.*

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* Account of the Inflammable Springs of Ontario county, by Dr. P. Hayes. New-York Medical and Physical Journal, III. 49.

† Silliman's Journal, XV., 237.

Through fissures in this rock in the creek near the village, are every where to be seen bubbles of gas rising through the water. The evolution, however, is most abundant at the bridge, and about three-quarters of a mile below. The gas, when collected in a proper vessel and fired, burns with a white flame tinged with yellow above, and blue near the orifice of the burner. Its illuminating power is not inferior to that of ordinary coal gas. When mixed with atmospheric air and ignited, it explodes violently. It contains no admixture of sulphuretted hydrogen.

The illuminating power of this gas and its abundant supply, suggested the idea of its employment in lighting the village. A copious discharge of the gas was observed issuing from a fissure in the rock which forms the bed of the creek, which it was thought could be diverted to a boring on the bank. A shaft was accordingly sunk through the slate about twenty-two feet in depth, which occasionally passed through layers of the bituminous substance already described, and the result was that the gas left the creek and issued through the shaft. By means of a tube, the gas was now conducted to a gasometer, and from thence to different parts of the village. The gasometer had a capacity of about two hundred and twenty cubic feet, and was usually filled in about fifteen hours, affording a sufficient supply of gas for seventy or eighty lights.

Bubbles of the same gas are here and there seen rising through the water in this creek for nearly three quarters of a mile below the village. But the largest quantity is evolved at the latter point. It was not possible for me with any apparatus which I could command, to determine the amount of gas given out at this place in a given time; but bubbles rise with great rapidity from an area of more than twenty feet square, and I should probably be warranted in asserting that it is five or six times greater than that obtained at the village.

At Van Buren harbor, on Lake Erie, four miles from Fredonia, bubbles of inflammable gas may be seen rising through the water, when the lake is calm, a rod or two from the shore. In the town of Sheridan, six and a half miles from Fredonia, the same gas is also abundantly evolved in various places. And a short distance below Portland harbor, near the shore of the lake, there is supposed to be a sufficient supply of it to light a city. It is employed in the light-house at the harbor seventy-five feet above the level of the lake.

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* This rock has been called bituminous limestone ; but I could find no specimens that effervesced with acids.

To these localities, I may also add another which I visited in company with Drs. Walworth and White, and Mr. Storke, situated in the valley of the west branch of the Canadawa creek, four miles southeast of Fredonia. Here is a spring in a marsh which has a whitish color, caused by the bubbles of gas which rise through the clay forming the bed of the spring. The water is fresh and pure, and has a temperature of about 50° F. The gas, when collected and forced through a small orifice, burns with a blueish white flame.

General views.—The evolution of this gas is so abundant, and extends over such a large surface, that we must refer its origin to some general cause. The strata of slate, as I have already remarked, have thin seams or patches of a bituminous matter, which burns with a flame entirely resembling that of the gas which is so copiously disengaged through its fissures. With this slate, there alternates a sandstone, which every where contains small cavities filled with petroleum; and all the specimens of which give out a strong bituminous odour. This liquid substance appears to have originally been diffused throughout the whole mass of the rock, both sandstone and slate, and to have given to it the peculiar character which it now possesses.

It is probable that the gas so copiously discharged, is formed by the action of heat upon the bituminous matter thus generally diffused through the strata of sandstone and slate; or it may be that the same matter which, in the upper strata is solid or liquid, is, at greater depths, the gas kept in a liquid form by the pressure of the superincumbent strata. A fact which I observed at Fredonia, confirms this view, and in my opinion proves that there is at some distance below the surface, a vast reservoir of gas, the evolution of which is prevented by the pressure exerted upon it. The fact to which I refer is, that when the water in the creek is low, bubbles of gas are often observed, which disappear entirely when the water has risen, as after a rain. And again, gas may be obtained at almost any part of the bank by boring to the depth of twenty or thirty feet. So common, indeed, is this occurrence, that many of the wells in the village of Fredonia are strongly charged with the gas. It may also be added, that there are frequently to be observed in this vicinity disruptions in the strata of slate, which have probably been caused by some expansive force exerted from beneath.

Mr. Storke, one of the engineers on the Buffalo and Erie rail-road, obligingly furnished me with the height of several points in the vicinity of Fredonia, from which some conclusions can be drawn concerning the thickness of the strata which are impregnated with this bituminous matter.

It will be recollected that the gas issues through the strata of slate which form the bed of Lake Erie, as at Van Buren harbour.

The slate on the bank of the Canadawa creek, at Fredonia, through which the carburetted hydrogen issues, is a hundred and twenty-seven feet above the level of the lake.

The Laona sandstone quarry, the rocks of which contain petroleum, and have a strong bituminous odour, is two hundred and forty one feet above the level of the lake.

The gas spring, four and a half miles southeast of Fredonia, is four hundred and eighty-one feet above the level of the lake.

On the west branch of the Canadawa creek, six miles south of Fredonia, at the height of six hundred and seventy-four feet above the level of the lake, the same slate occurs.

Three miles northeast of Jamestown, at the height of nine hundred and twenty-six feet above the level of the lake, is a quarry of sandstone.

The strata of sandstone and slate are, therefore, ascertained to be nearly a thousand feet in thickness.

Extending the computation to the other strata through which this gas is evolved, we find it at Albany upwards of four hundred feet below the surface, or about three hundred and seventy feet below tide issuing through slate.

At Vernon, in Oneida county, through the red sandstone, nearly four hundred feet above tide.

At Gasport, six and a half miles east of Lockport, through limestone, nearly five hundred feet above tide.

If Lake Erie is five hundred and sixty-five feet above tide, we have this same gas issuing from strata from fifteen hundred to two thousand feet in thickness, and not less than four hundred miles in extent.

The above facts afford the most convincing proofs that the evolution of this gas is no evidence of the existence of coal at any moderate depths below the surface; unless, indeed, the views which are at present entertained concerning the geological situation of this mineral are entirely erroneous. And although carburetted hydrogen frequently has its origin in beds of bituminous coal, the facts which have just been detailed, tend to show that its occurrence does not necessarily depend upon such an agency.

NITROGEN SPRINGS.

Springs evolving nitrogen gas are by no means common in the State of New-York. A few, however, occur which possess considerable interest in consequence of the quantity of that gas, which they give out. There are, moreover, some springs to be noticed, under another head, among the gaseous constituents of which is an air that contains a larger proportion of nitrogen than is present in the atmosphere.

Lebanon Springs.—The most remarkable nitrogen spring in the State, is the one at Lebanon, in the county of Columbia. This spring is about ten feet in diameter and four feet deep, and discharges a large amount of water. Its temperature is uniformly 73° F., while that of all the other springs in the vicinity is 52°. The water is quite tasteless. Its specific gravity is scarcely above that of distilled water, as it holds only a minute portion of saline matter in solution. The following is the composition, according to the analysis of Dr. Meade, of a a pint of the water.

Chloride of calcium,	0.25	grains.
Chloride of sodium,	0.44	"
Carbonate of lime,	0.19	"
Sulphate of lime,	0.37	"
	1.25	

Bubbles of air, continually rise through the crevices of the rock at the bottom of this spring, which ascending rapidly through the water occasion an incessant agitation, and appear to break on the surface without being at all absorbed by the water. This air is given out in the proportion of about five cubic inches from a pint of the water, and it consists, according to the experiments of Prof. Daubeny, of Oxford, now on a visit to this country, who kindly furnished me the results, of 89.4 parts of nitrogen, and 10.6 parts of oxygen, in the hundred. This is equal to nearly fifty parts atmospheric air, and fifty parts pure nitrogen, in the hundred. Prof. Daubeny could not detect any carbonic acid in the gaseous matter given out by this spring.

So large is the quantity of water at the Lebanon Springs, that advantage has been taken of it, and of the elevation of the ground not only to supply all the baths, but to turn two or three mills erected within a short distance; these mills are kept in action during the severity of the winter.

Rensselaer Nitrogen Springs.—Springs evolving nitrogen gas are also found in the southeast corner of the town of Hoosick, in Rensselaer county, six miles southeast of the village of Bennington, in Vermont. Of these, Prof. Eaton gives the following description: "There are three springs comprised within about four or five acres of ground. The quantity of pure nitrogen gas which issues in the form of bubbles from these springs is incalculable. The gas does not seem to be combined with the water, but to issue from the gravel beds beneath the water of the springs. And we have no good reason for saying that the gas is confined to the bed of these springs. It may constantly issue from the dry parts of the soil in their immediate vicinity, and become manifest only where the water covers the soil, by bubbling through it. By pressing upon a surface of the gravel, equal to five or six inches square, a quart of the gas may be collected in an inverted jar or bottle in ten seconds."*

Chateaugay Springs.—To the above, I can add only the springs of Chateaugay, in Franklin county. These springs rise from a white sand, and from them there is a flow of water sufficient to turn a mill wheel. The water is quite cold, but bubbles of nitrogen gas continually rise from the bottom.† It must also hold in solution some calcareous salts, as tufa is abundantly formed in the vicinity.

The origin of nitrogen gas in springs has been referred by some to the decomposition of animal matter in the interior of the earth; but a much more consistent theory is that which ascribes it to certain processes going on in the interior of the earth, which occasion the abstraction of oxygen from common air.‡

ACIDULOUS OR CARBONATED SPRINGS.

By acidulous, or carbonated waters, I mean those which are charged with a considerable proportion of carbonic acid, giving to them a peculiar sparkling character, and which also contain some alkaline carbonate as one of its constituents.

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* Geological Survey of Rensselaer county, N. Y. p 29.

† Professor Emmons' Geological Report for 1837.

‡ Prof. Daubeny's Report on Mineral and Thermal Waters, in the Report of the British Association for the advancement of Science, for 1836, page 72.

The springs belonging to this class in our State, although not very numerous, are several of them quite celebrated, and have been for a long time great centres of attraction and sources of wealth.

Saratoga Springs.—At the head of the list are undoubtedly to be placed the waters of the Saratoga springs. These, in consequence of the high reputation which they have enjoyed, have often been made the subjects of chemical examination, and on this account it will be the less necessary for me to devote much time to them in the present report. Indeed, were it not that I am desirous of presenting a general view of our carbonated waters, I should be content with the simple reference to the detailed and valuable description of those of Saratoga, published by Dr. Steel.*

One of the earliest notices of these springs, is that of Samuel Tenny, contained in the second volume of the Memoirs of the American Academy of Arts and Sciences. In 1793, Dr. Valentine Seaman published a dissertation on the mineral waters of Saratoga, and indicated with as much accuracy as the state of chemical analysis then admitted, their chemical composition.† But the later analyses of Prof. J. F. Dana and Dr. Steel are more exact, and have given us a more correct knowledge of their constituents.

It is well known that there are a number of springs at Saratoga, the waters of which bear a general resemblance to each other. But owing either to some difference in the chemical composition, or to the influence of fashion, some particular spring has always been more celebrated than all the rest. Such is at present the case with the Congress spring, and the chemical composition of its waters will unfold to us that of several others found in its immediate vicinity.

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* An Analysis of the Mineral Waters of Saratoga and Ballston, with practical remarks on their Medical Properties, &c. &c. By John H. Steel, M. D.—1831.

† See also some remarks by the same author upon the analysis of Ballston water, by Prof. Caizalet, of Bordeaux, in the Medical Repository, XI. 253.

Composition of a pint of the water from the Congress Spring.

According to Prof. J. F. Dana.	Grs.
Chloride of sodium,	54.3
Carbonate of lime,	18.0
Carbonate of magnesia,	4.0
Carbonate of soda,	2.0
Silica, with a trace of iron,	
Total,	78.3

	Cubic inches.
Carbonic acid gas,	39.1
Azote,	0.9
Gaseous contents,	40.0

According to Dr. Steel.	Grs.
Chloride of sodium,	48.13
Hydriodate of soda,	0.44
Bicarbonate of soda,	1.12
Bicarbonate of magnesia,	11.97
Carbonate of lime,	12.26
Carbonate of iron,	0.63
Silica,	0.19
Hydrobromate of potassa, trace,	
Total,	74.73

	Cubic inches.
Carbonic acid gas,	39.00
Atmospheric air,	0.87
Gaseous contents,	39.87

The temperature of these springs is said to be uniformly 50° F.

Ballston Springs.—The springs at Ballston are mostly situated in the valley of the stream which passes through the village. The bed of this stream is slate, and it is probably in this formation that the carbonated waters have their origin.

An interesting group of springs occur in this village near the present bathing house. Here we have the United States spring, which is acidulous; at the distance of nineteen feet is the Fulton Chalybeate spring; while in an opposite direction, and within twelve feet of the former, is the Franklin sulphur spring. Thus there are three springs, differing considerably in their chemical composition, rising within a few feet of each other. The United States spring is highly charged with carbonic acid gas, while the others contain only a small portion of it.

From several of the springs at Ballston, there is a discharge of gas in smaller or larger bubbles, which does not unite with the water. At the Park spring in rear of the Village Hotel, minute portions of gas are continually rising through the water, but at an interval of a minute the whole well is agitated by the evolution of a comparatively large bulk of the gas. This gas, which in all cases is the carbonic acid, also rises in great abundance through the water of a well near Low's spring and in various places in the valley of the stream. A few years since there was a very remarkable and indeed almost volcanic discharge of it near the old factory, which threw up the water of the creek several feet into the air, but the gas soon diminished greatly in quantity, and can now be observed rising only in small bubbles through the bed of the stream.

From these facts it is evident that here, as at Saratoga, there are certain agencies in operation which cause an abundant evolution of carbonic acid. That this gas originates at great depths and rises freely through crevices in the rock, is rendered probable from its alternately breaking out and disappearing at points somewhat distant to each other. And perhaps the opinion of Berthier may here be applied, viz. that the water of the spring is forced up by the elasticity of the confined gas.

The phenomena presented at Ballston, so far at least as the evolution of carbonic acid is concerned, are quite analogous to those noticed by Brandes and Kruger in their account of the mineral waters of Pyrmont, that the extrication of this gas is by no means limited to the spot from whence the chalybeate springs of that watering place arise, but is observed for some distance round, wherever fissures, natural or artificial, exist. Thus, a cavity having been made by some workmen for quarrying stone, it was found that the air became charged with from thirty-six to forty-eight per cent of carbonic acid, which rose in the cavern to different heights at different times.*

In general, the occurrence of carbonic acid in these waters is to be ascribed to the existence of large quantities of it held in solution by water at great depths, and therefore under enormous pressure; or by the gas itself being kept by the same agency in a liquid form, until by the removal of the pressure, it assumes the gaseous state, and is thus disengaged.

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* Quoted by Professor Daubeny in his Report on Mineral and Thermal waters, p. 37.

It is very difficult to estimate with accuracy the proportion of carbonic acid which these waters contain, as they are continually pervaded by gas, which apparently has no action upon its constituents. Perhaps the best guide in this part of the investigation is to determine the amount of gas necessary to hold the solid carbonates in solution, as they undoubtedly exist in the state of bicarbonates. The following tables will exhibit the composition of one of the Ballston waters:

United States Spring.

Specific gravity, 1.00611. Temperature, 50° F. One pint of the water contains,

Carbonate of lime, with a small admixture of oxide of iron,	3.65	grains.
Carbonate of magnesia,	0.72	"
Carbonate of soda,	2.11	"
Sulphate of soda,	0.22	"
Chloride of sodium,	53.12	"
Silica,*	1.00	"
	60.82	"

Carbonic acid 30.50 cubic inches.

Low's well, recently restored, has a composition similar to the preceding, but the amount of saline matter is much less. Its specific gravity is 1.02548, temperature 50° F. *Park Spring*, situated in rear of the Village Hotel, has also the same constituents, but the iron is in much larger proportions than in any of the waters in this vicinity.

Albany Mineral Spring.—A spring similar to those of Saratoga and Ballston, was discovered in the city of Albany in 1827. Messrs. Boyd and McCulloch, the proprietors of a brewery in Ferry-street, in the hope of obtaining pure water on the premises in sufficient quantity for the supply of their establishment, commenced boring upon the plan of Mr. Disbrow, during the year 1826. After descending to the depth of about four hundred and eighty feet, the water which rose nearly to the surface, was found to have a saline taste and a sparkling appearance. At the request of the proprietors, I analyzed a portion of this water, and found its composition to be as stated below. There was also observed rising through the water an inflammable gas, which was found to be carburetted hydrogen. The boring was continued about six hundred feet through the slate rock, and the flow of carbonated water and inflammable gas continued. The obtaining of fresh water being therefore considered hopeless, a tube was sunk to prevent the admixture of the carburetted hydrogen with the mineral water, and an apparatus constructed for raising a supply of the latter.

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* This water probably contains both iodine and bromine. but the quanty upon which I operated was too small to admit of separating them and determining their relative proportions.

Subsequently, Mr. McCulloch commenced boring a few rods from this place, when, at about the same depth, the vein of mineral water was again struck. It was also accompanied by the inflammable gas, as in the former case. And to add to the interest of the locality, it was, moreover, found that at the depth of about thirty feet from the surface, a vein of water was crossed which was highly charged with sulphuretted hydrogen gas. We have then in the same slate formation, though at different depths, sulphuretted hydrogen, carburetted hydrogen and carbonic acid gases, abundantly evolved.

Another curious fact noticed at the locality now under consideration was, that when the pump in the present Mineral garden was put in operation, the level of the water in the other well was soon reduced, and it was at length rendered entirely valueless. It may hence be inferred, that there is here a subterranean vein of mineral water, and from the general similarity in its composition to that of the springs of Saratoga and Ballston, is not improbable that this vein is of considerable extent. Nor would it be at all surprising if carbonated water should be found by boring to a sufficient depth at any place in the range from Albany to Saratoga, where its discovery should be thought of sufficient importance to warrant the necessary expenditure.

The occurrence of carbonic acid in all these waters, has been ascribed with some plausibility to the reciprocal action and decomposition of the sulphuret of iron and carbonate of lime, contained in the strata of argillite, in which they exist. But if this view is correct, it is not easy to account for the absence of sulphate of lime, a salt so generally found in mineral springs, and which would, by this supposed process, be abundantly formed. And it leaves still unaccounted for the singular fact, that in the same rock formation different gases are given out at different depths, and appear to be, as far as their origin is concerned, entirely independent of each other. Thus at the Albany spring, sulphuretted hydrogen rises from about thirty feet below the surface, and when a tube is sunk below this, the water contains no admixture of this gas; again, at the depth of about four hundred feet, the carburetted hydrogen appears, and lastly, the carbonated water. We must, therefore, refer the production of these gases to more general, and probably more effective agencies.

It may be proper to state, as it may throw some light upon this interesting subject, that at the Albany spring a tube is sunk into the boring about a hundred feet, and to it is attached a pump for raising the water into a cistern. When the pump has been worked for some time, the sulphur water sinks below the surface of the ground, and again appears, when the pumping has ceased. After the mineral water is discharged from the cistern, and the pressure is thus relieved, the inflammable gas flows out. It burns with a reddish white flame, blue at the base. Neither this gas nor the water contain the least portion of sulphuretted hydrogen.

Composition of the Albany mineral water.* In one pint. Specific gravity at 60° F. 1.00900. Temperature 51° to 52°.

Chloride of Sodium,	63.00	grains.
Carbonate of Soda,	5.00	"
Carbonate of lime,	4.00	"
Carbonate of magnesia,	2.00	"
Carbonate of iron with a little silica,	1.00	"
	75.00	"

Carbonic acid, 28 cubic inches.

The following is Dr. Meade's analysis of the water, from the same spring, subsequently procured:

Chloride of sodium,	59.00	grains.
Carbonate of soda,	5.00	"
Carbonate of lime,	4.00	"
Carbonate of magnesia,	1.50	"
Carbonate of iron,	1.00	"
Muriate of lime,	0.50	"
	71.00	"

Gaseous contents, 26 cubic inches.

Halleck Spring.—A spring has recently been discovered in Oneida county, which appears to deserve a place in this class. It is situated about half a mile northeast of the village of Hampton, in the town of Westmoreland, and was the result of a boring into a solid rock of a hundred and six feet. The following is the composition of one pint of this water, according to the analysis of Prof. J. Noyes, formerly of Hamilton College.

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* The portion of this water which I analyzed, was obtained from the boring, soon after its mineral character was first noticed. The amount of carbonate of iron obtained from it was not, as I have since learned, all chemically combined. I have accordingly made the proper correction.

Chloride of sodium,	78.00	grains.
Chloride of calcium,	13.00	"
Chloride of magnesium,	4.00	"
Sulphate of lime,	5.00	"
	100.00	"

This spring is highly charged with carburetted hydrogen, and contains a small quantity of carbonic acid.

New-York Spring.—The only remaining spring to be noticed under this head, is the one opened some years since in Cliff-street, in the city of New-York, of which an analysis was made by the late Mr. George Chilton. If the published results are correct, this water is more complex in its composition than any hitherto found in this State. A pint of this water contains 18.74 grains of saline matter, and 9.14 cubic inches of carbonic acid and atmospheric air.*

SULPHURETTED, OR SULPHUREOUS SPRINGS.

Sulphuretted springs, or such as have their waters charged with sulphuretted hydrogen gas, are of very frequent occurrence in this State. Indeed, there is scarcely a single county in which they are not found. They may of course always be known by their unpleasant odour, and if strongly charged with the gas, by the effect which they have of blackening silver and the solution of sugar of lead.

Sulphur Springs on the Hudson.—Commencing in the southern part of the State, sulphuretted springs are found at short intervals, from near Sing-Sing, in Westchester county, to Fort-Miller, in Washington county, a distance of nearly a hundred and fifty miles. They occur on both banks of the Hudson, and usually rise through the strata of glazed black slate which is found throughout nearly the whole of this extent. Under this head, may be enumerated the Chappequa mineral spring, three and a half miles east of Sing-Sing; one near the village of Newburgh; one in the city of Hudson; the springs at Coeymans' Landing; in Guilderland, in Wendell's hollow, in the city of Albany; in Watervliet; the

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* The entire analysis will be found in Silliman's Journal, XVIII. 346.

Harrowgate spring, in Greenbush; one near the north end of the city of Troy; and others in various places near the springs of Ballston and Saratoga.

The sulphuretted waters found in the region just designated, are usually impregnated with the gas in sufficient quantity to change the colour of solution of acetate of lead; but in some instances the quantity is so small as to be only perceptible by its odour. The gas is probably the result of the decomposition of the sulphuret of iron, which is always disseminated through this slate rock. And as carbonate of lime is also found, though in small quantities, in the same formation, we can very well account for the existence of sulphate of lime being so general in these waters.

Sulphur Spring in Clinton county.—Some interesting sulphuretted springs occur in the northern counties of the State. Thus in the town of Beekman, in the county of Clinton, is a spring of this kind becoming somewhat noted, where a commodious house for the accommodation of visiters has been erected. The water of this spring is said to contain sulphur, iron and carbonic acid, but I have not yet had an opportunity of examining it.

Sulphur Springs of St. Lawrence county.—St. Lawrence county, that great depository of mineral wealth, has long been celebrated for the sulphuretted springs which it contains. Of these, probably the most important is that situated about a mile from Massena, on the banks of the Racket river. The water of this spring is strongly charged with sulphuretted hydrogen, and also holds in solution carbonates of soda, lime and magnesia. Several other springs of a similar kind are to be found on the banks of the same stream, and they are more or less resorted to by the inhabitants of this and the adjacent counties.

Sulphuretted springs frequently occur in the county of Lewis, but none of them, I believe, have acquired much celebrity.

Sulphur Springs of Western New-York.—It is in the district adjacent to the Erie Canal that these waters are more frequent, as well as more interesting in their nature, than they are in any other part of the State. And it is a striking fact, that they rise here through strata of rocks entirely different from those with which they are associated on the Hudson river. In what may be called the canal district, the rocks are usually limestone, or contain large admixtures of carbonate of lime, while gypsum, or the sulphate of lime, is also found in great abundance in various parts of it. It may also be remarked in this place, that probably the same agencies which have caused the formation of the gypsum, have also given rise to the production of the sulphuretted hydrogen. Their origin may, I think, without violence, be ascribed to the action of water upon the sulphurets of calcium, magnesium, &c. which not improbably exist at great depths. The result of this action would be the evolution of vast quantities of sulphuretted hydrogen, and the consequent formation of sulphate of lime. It may also be stated, that the existence of such a compound in the interior of the earth is in entire accordance with the views entertained by many philosophers, concerning the cause of volcanic action, to which, indeed, the production of these, as well as that of several other springs, may perhaps be most properly referred. These views, however, will be more fully unfolded in the notices which I shall present of the more important sulphur springs found in the western and south western parts of the State.

Sharon Springs.—Near the village of Leesville, in the town of Sharon, and county of Schoharie, is a spring highly impregnated with sulphuretted hydrogen, which has acquired a high reputation for the cure of those diseases which are known to be relieved by waters of this description. It is represented as having the characters of the Virginia springs. Its waters, flowing over vegetable substances, encases them in a covering of sulphur. So abundant is the evolution of the sulphuretted hydrogen gas from this spring, that the metals are quickly tarnished in their vicinity. Mr. Gordon states, that a quarter of a mile from their source, though flowing with fresh water, it preserves its distinctive character, to a ledge of rocks, over which it falls perpendicularly sixty feet, and has a volume sufficient to drive a grist mill.*

It is worthy of remark, as illustrating the origin of these waters, that sulphate of lime is found near the spring in considerable quantity.

In Otsego county, the town of Richfield contains some sulphuretted springs in repute, and much frequented; but I have not yet had an opportunity of ascertaining their chemical composition.

Prof. Eaton has stated that sulphuretted hydrogen gas issues from a spring on the Otsquago creek, ten miles south of Fort-Plain, on the Erie canal. The gas burns along the surface of the water, with a bright red flame, by day light. It issues from the water continually, at the rate of a little more than a gallon in a minute.†

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* Gazetteer of the State of New-York.

† Silliman's Journal, XV. 235.

Verona Spring.—We come next to the sulphuretted springs of Oneida county, some of which possess a high degree of interest. One of them is in the town of Verona, fourteen miles from Utica. Its water has been analyzed by Professor Noyes. The following is the composition of one pint.

Chloride of calcium, with chloride of magnesium,	8.50	grains.
Sulphate of lime,...........................	7.50	"
Chloride of sodium, ...	90.00	"
	106.00	"

The water is supposed to be nearly saturated with sulphuretted hydrogen gas.

Saquoit Springs.—In the town of Paris, in the same county, nine and a half miles south of Utica, are the Saquoit mineral and burning springs, the waters of which are highly charged with sulphuretted hydrogen, and contain the chlorides of sodium and magnesium in considerable quantities, together with a little sulphate of lime and a trace of iron. The gas rises from the water in such abundance as to allow of its being conducted through tubes, and to be kept constantly burning.

Chittenango Springs.—In the county of Madison, the sulphuretted springs of the most importance are those in the vicinity of the village of Chittenango. They are situated in the valley of the Chittenango creek, and issue from the hill of calciferous slate, which here forms its eastern boundary. One of these springs is on the lands of the late John B. Yates, Esq. about a mile south of the village. The temperature at the time of my visit was 49° F.; its water is limpid, and emits a strong odour of sulphuretted hydrogen, with which it is sufficiently charged to blacken silver, and the salts of lead. The following is the composition in a pint, according to my analysis. Specific gravity, 1.00341.

Carbonate of lime,........................	0.88	grains.
Sulphate of soda,.........................	1.66	"
Sulphates of lime and magnesia,.............	12.75	"
Chloride of sodium,........................	0.14	"
Organic matter,............................	trace.	"
	15.43	"

Besides the sulphuretted hydrogen, the water contains a small portion of carbonic acid.

Another interesting spring is found on the farm of Judge Warner about two miles south of the village. The water at this place rushes out of a crevice in the rock, at the rate, according to the measurement of Mr. Warner and myself, of about thirty-eight gallons in a minute. When fresh from the spring, it has an opaline or milky appearance, and a strong sulphureous odour. This milkiness I found it to retain, even after eighteen hours exposure to the air. Upon being boiled, the water becomes clear, and a whitish precipitate is deposited, which is principally sulphate of lime, to which, indeed, its peculiar appearance may be ascribed. All the sulphur springs which I have thus far examined, with this single exception, are perfectly limpid; and Mr. Warner has given this the characteristic name of the Chittenango White Sulphur Spring.

The temperature of this spring is about 49°. Its water is so strongly charged with the sulphuretted hydrogen gas, that its odour is not only perceptible at a considerable distance, but its peculiar chemical effect is to be observed upon the bathing and lodging houses in the vicinity. Its specific gravity is 1.00254. The following is the composition in a pint.

Carbonate of lime,	1.33	grains.
Sulphate of lime,	8.22	"
Sulphate of magnesia,	3.11	"
Chloride of sodium, and vegetable matter, a minute quantity,		
	12.66	"

Like the preceding spring, it contains a portion of carbonic acid, which holds the carbonate of lime in solution. In the vicinity of each of them are to be found leaves, twigs and pieces of wood, covered with a whitish incrustation, which on examination proves to be free sulphur, together with sulphate and carbonate of lime.

The waters just described are highly esteemed in many cases of disease, and their location is so eligible, that I do not doubt that when they are better known, they will be much resorted to. And here it may be remarked, that the village of Chittenango is, on several accounts, a point of considerable interest. In addition to the sulphuretted and petrifying springs found in the immediate vicinity, there are extensive beds of gypsum, and fine quarries of the grey limestone, one of the most beautiful and durable of building materials. I was informed that in the town of Sullivan alone, there are raised from 4,000 to 7,000 tons of gypsum annually, having an average value of a dollar a ton. Finally, inexhaustible quarries of hydraulic limestone occur about a mile and a half rom the village. About 100,000 bushels of the lime obtained from this deposit are annually sent from this town, the average price of which is fourteen cents a bushel, making a total of fourteen thousand dollars.

Onondaga Springs.—The sulphuretted springs of Onondaga county are more numerous than those of Madison, or at least a greater number have already been made known.

About a mile from Manlius Square are three springs very near to each other, all of which are feebly charged with sulphuretted hydrogen. They have also a slightly saline taste, and have acquired some reputation in the vicinity.

It is remarked by Prof. Eaton, that the most interesting locality of sulphur water which has fallen under his notice, is what has been named Lake Sodom, about twenty rods south of the Erie canal, two miles east of Manlius Centre. The bottom is grass green ferriferous slate, the sides white shell marl, and the brim is black vegetable mould. The water is perfectly limpid. The whole appears to the eye to be a rich porcelain bowl, filled with limpid nectar, but to the taste it is the true Harrowgate water, and readily convinces the visiter of the correctness of the name.*

Sulphuretted hydrogen gas is evolved in great quantites in the immediate vicinity of the salt springs at Salina and Syracuse. On the grounds of Mr. E. F. Wallace, of Syracuse, there rises out of the earth in the bed of a small ravine, water strongly charged with this gas, and containing also some carbonic acid, together with a large proportion of saline matters. This spring is situated about forty rods from the Syracuse brine well. Its water is perfectly transparent, blackens salts of lead, but has scarcely more than a trace of iron.

Analysis of the Wallace Sulphur spring. Specific gravity, 1.01426. Composition in one pint.

Carbonate of lime, with minute portions of oxide of iron and silica,	1.74	grains.
Sulphate of lime,	7.97	"
Chlorides of calcium and magnesium,	1.07	"
Chloride of sodium,	122.86	"
	133.64	"

Gaseous substances, sulphuretted hydrogen and carbonic acid.

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* Silliman s Journal, XV. 235.

Another spring, quite similar in its character to that just described, is found on the marsh, a short distance from the Salina well, and about a mile from the preceding.

Composition of the Salina sulphur spring in a pint.

Carbonate of lime, with minute portions of iron and silica,	0.58	grains.
Sulphate of lime,	11.18	"
Chlorides of calcium and magnesium,	0.96	"
Chloride of sodium,	173.69	"
	186.41	"

Gaseous matters, sulphuretted hydrogen, with a minute portion of carbonic acid.

These waters, therefore, seem to be weak brines, charged with sulphuretted hydrogen, and it is a fact of some interest in connection with the history of the brine springs of this region, that the gas just mentioned is also evolved in considerable quantity by many of the pools and small collections of water found in their vicinity. To this may be ascribed, with much plausibility, the origin of the sulphate of lime, so constantly associated with the common salt in all the Onondaga brines.

In the town of De Witt, three miles northeast of Syracuse and a mile north of the Erie canal, are the Messina sulphur springs. They are situated in a ravine, similar to that in which are found the springs of Manlius and Chittenango, and they rise through a limestone formation, on the surface of which are every where found masses of calcareous tufa. The temperature is uniformly 50° F. The water has a strong sulphureous taste, but is not so highly charged with the gas as that of other springs. When it has been exposed to the air for a few hours, it becomes milky, no doubt in consequence of the decomposition of the sulphuretted hydrogen and the subsidence of some of the less soluble salts. The whitish crust usually found near springs of this class, is observable here, and the tufa so abundantly met with undoubtedly owes its formation to waters similarly constituted. I need scarcely add, that this water is used with good effects in many diseases.

The following is the composition of the water from the Messina sulphur spring, Onondaga county, in a pint. Specific gravity, 1.00305.

Carbonate of lime,	1.85	grains.
Sulphate of lime,	8.55	"
Sulphate of magnesia,	1.36	"
Chloride of calcium,	1.33	"
	13.09	"

The number of springs belonging to the class which I am now considering, seems to increase as we proceed westwardly, so that it is scarcely possible in a report like the present, to do more than to notice briefly some of the most important of them.

Cayuga Sulphur Springs.—In the county of Cayuga are several sulphurretted springs. One of these is in the town of Sennett, two miles north of the village of Auburn. Another, which has also acquired some reputation, is situated about four miles west of Auburn, on the farm of Mr. Nelson Van Ness. It is called West-Auburn spring. One pint of the water according to the analysis of Dr. Chilton of this city, contains the following matter, viz:

Sulphate of lime,	15.00	grains.
Sulphate of magnesium,	3.20	"
Chloride of magnesium,	0.25	"
Chloride of sodium,	0.75	"
	19.20	"

Sulphuretted hydrogen gas, 1.5 cubic inches.

At Spring Mills on the eastern shore of Cayuga lake a sulphuretted water is said to issue from the earth in quantities sufficient for turning a grist mill. The water is perfectly limpid, and notwithstanding the large stream which is continually flowing, the taste and odour of sulphuretted hydrogen are very strong.

Monroe Springs.—Sulphuretted springs are found in great numbers in the county of Monroe. Among them may be mentioned those of Rochester, Mendon, Gates and Pittsford, at all of which there are bathing houses and ample accommodations for visiters. At the village of Ogden, in the town of the same name, one and a half mile south of Spencer's basin, is a spring probably more highly charged with the gas than any other in the county.

In the city of Rochester, on the east bank of the Genesee, is Longmuir's sulphur spring, the waters of which are much employed by the inhabitants. It rises through a boring of two hundred feet in depth, which was commenced by the Messrs. Longmuir in the hope of obtaining a supply of pure water for their brewery in the immediate vicinity. One of the proprietors informed me that the evolution of sulphuretted hydrogen, was first observed at the depth of fifty feet below the surface, which would be within the strata of calciferous slate.

The temperature of Longmuir's spring, is usually 52° F. The water when heated to about 100°, deposits sulphur and carbonate of lime. The specific gravity is 1.00407. One pint of this water contains,

Carbonates of lime and magnesia with a trace of oxide of iron,	1.48	grains.
Chloride of sodium,	6.52	"
Sulphate of soda,	6.99	"
	14.99	"

Gaseous contents, sulphuretted hydrogen, 2.16 cubic inches, with a small quantity of carbonic acid.

To show how abundantly sulphuretted hydrogen is evolved in this district, it is only necessary to notice the Caledonia springs in the town of Wheatland, where a large volume of water gushes out of the earth, forming a stream nearly one quarter the size of the Genesee river at Rochester, the whole being slightly impregnated with this gas.

Genesee Springs.—In the county of Genesee, we have, near North Byron, a sulphuretted spring, the gas of which is so copiously given out as to be inflamed; and in the southeast part of the same town are springs of a similar kind.

A very remarkable locality in this vicinity deserves to be particularly noticed here, as the occurrence is undoubtedly to be referred to the same general agencies which are concerned in the production of sulphuretted hydrogen. I refer to the *Sour Spring*, so called, which exists in Byron, near the canal. The acid is produced from a hillock about 230 feet long and 100 broad, elevated four or five feet above the surrounding plane. According to Prof. Eaton, the strenght of the acid increases in a drought. He states, that when he examined the locality considerable rain had recently fallen, and the acid in most places was very dilute, but in some it appeared to be perfectly concentrated, and nearly dry in its combination with the charred vegetable coat. In this state it was diffused throughout the whole hillock, which was every where covered with charred vegetable matter to the depth of five to thirty or forty inches, occasioned by the action of the sulphuric acid. Wherever holes were sunk in this hill the acid accumulated, and also in the depressions of the contiguous meadow grounds.

There is another locality of a similar kind a hundred rods west of Byron hotel, and two miles east of the former, which is remarkable, in consequence of the great quantity of acid. It is a spring which issues from the earth, in sufficient volume to turn a light grist mill. Such an immense laboratory of sulphuric acid is here conducted by nature, that all the water which supplies this perennial stream possesses acidity enough to give the common test with violets, and to coagulate milk. Besides the above, there are said to be several other sour springs in this vicinity.*

I have particularly examined both the liquid acid and the brownish vegetable matter subjected to its action.

The liquid is transparent and colourless; and in the specimen upon which I operated, had a specific gravity of 1.11304 at 60° F. It reddens litmus powerfully, has an intensely sour taste, causes a dense precipitate when added to muriate of barytes, but is not affected by nitrate of silver. When ammonia is added to the liquid to saturation, a slight precipitate of a reddish color is the result, and the clear solution is afterwards also slightly affected by oxalate of ammonia. The oxide of iron and lime indicated by the two latter tests are, however, in very small proportion, as is evident from the fact that when the liquid is evaporated it leaves only a trifling residuum. It is a nearly pure, though dilute, sulphuric acid, and not a solution of acid salts, as has been supposed; for the bases are in too minute proportions to warrant the latter opinion.

The brownish matter, or *acid earth*, is principally vegetable matter, charred by the action of the acid; but it also contains some silica and alumina, with a minute quantity of lime and oxide of iron. When this matter is boiled in water, a solution is obtained which possesses all the properties of the liquid just described. When heated for some time in a crucible to redness, the acid and vegetable matter disappear, and there remain a little sulphuret of calcium, formed by the decomposition of the acid and the lime, a trace of iron, together with the earthy matters above mentioned. I could not detect, either in the liquid, or in the solution of the earth, any other salt than those which I have already enumerated, unless, indeed, there should be some sulphate of alumine present.

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* Eaton in Silliman's Journal, XV, 239.

The occurrence of sulphuric acid in nature, in any thing like the pure form which it here possesses, is of great interest, only a few localities, and these rather doubtful, being hitherto known. An earth, somewhat similar to that found in Byron, is said to exist in great quantities at a village called Daulakie, in the south of Persia, between three and four days journey from Bushire, on the Persian gulf. The natives employ it as a substitute for lemons and limes, in making their sherbets, of which considerable quantities are drank, they being prohibited the use of wine. On analysis the acid was found to be the sulphuric, and this was united to iron; the solution in boiling water, when evaporated, yielding crystals which seemed to be the acid sulphate of that metal.*

Ontario Springs.—There is a locality somewhat similar to that in Byron, at Clifton springs, in the town of Phelps, twelve miles northwest of Geneva, in the county of Ontario. The acid may be extracted from the water, while the moss and other vegetables over which it passes become at length incrusted with sulphur. This locality was noticed at a very early period, by one whose name is identified with the history of the physical sciences in this country, and whose great acquirements gave him a conspicuous place among his cotemporaries. "Here," says he, "are several springs which discharge their waters and give rise to calcareous, as well as sulphureous deposits, which collect on the stones and other bodies wherever the current is gentle or approaches to stagnation. The water as it issues from the springs is perfectly transparent, but it soon becomes opaque and of a yellowish colour. At a short distance from this, are other sulphureous oozings, and the sulphur has gathered until a sort of marsh of perhaps ten rods in diameter has been formed."†

At the outlet of Canandaigua lake several sulphuretted springs flow from the limestone formation, and some of which are resorted to for medicinal purposes. The depositions of sulphur are extensive, and are observable on the plants and rocks of the vicinity.

Avon Springs.—Some of the most interesting and valuable sulphur springs, which this State possesses, are found in Livingston county. Those situated near the village of West-Avon are particularly deserving of notice. Three springs have already been discovered here, and as their chemical composition does not materially differ, it is probable that they exert similar effects on the animal economy.

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* Philosophical Magazine for 1824.

† See Dr. Samuel L. Mitchill's "Tour to Niagara," published in the Medical Repository, XIV. 412.

The first spring is called the Avon New Bath spring, and was discovered by the present proprietor, in 1835. Its depth is about thirty-six feet, and the formation through which the water rises is the calciferous slate similar to that found at Rochester, The temperature of this spring is about 50° F. The specific gravity of the water 1.00356.*

One pint of water from the Avon New spring contains

Carbonate of lime, ...	3.37	grains.
Sulphate of lime,...........................	0.44	"
Sulphate of magnesia,....................	1.01	"
Sulphate of soda, ...	4.84	"
Chloride of sodium,.......................	0.71	"
	10.37	"

Sulphuretted hydrogen, 3.91 cubic inches.

The middle spring is situated about thirty rods east of the former. Its temperature is 51° F. The following, according to Prof. Hadley, is the composition of a pint of this water.

Carbonate of lime,........................	1.00	grains.
Sulphate of lime,..........................	10.50	"
Sulphate of magnesia, ...	1.25	"
Sulphate of soda,..........................	2.00	"
Chloride of sodium,.......................	2.30	"
	17.05	"

Sulphuretted hydrogen,........	12.0	cubic inches.
Carbonic acid,................	5.6	do
Gaseous contents,............	17.6	do

The third or lower Avon spring is undoubtedly similar in its composition to the preceding, but I have not yet had an opportunity of subjecting it to analysis. It is remarkable for the large volume of water which it discharges. This has been estimated to be equal to fifty-four gallons in a minute, and I apprehend that this is not far from correct.

The waters of all the Avon springs give out powerfully the odour of sulphuretted hydrogen, and have a strong saline taste. They speedily blacken silver and the salts of lead. The solution of arsenious acid is but slightly altered by it until after the addition of an acid; from which I infer that a portion of the sulphuretted hydrogen is in a state of combination with some basis.

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* The water of this spring, when heated, assumes a beautiful green colour, the cause of which I have not yet been able to determine. I intended to have made careful analyses of the waters of all these springs, but in consequence of my not receiving the specimens for the purpose, I am obliged to defer them until the next season.

The situation of the village of Avon in one of the most beautiful and fertile portions of western New-York, and the valuable medicinal qualities of its springs, conspire to render this one of the most attractive watering places in the State.

Niagara Springs.—The county of Niagara is no less abundantly supplied with sulphur springs than those which have been already noticed. One of these occurs in the town of Pendleton near the canal, others are found in the neighborhood of Lockport and near the Falls of Niagara; but neither of these have, I believe, been hitherto particularly examined.

In the museum of the Albany Institute, is a bottle of water from a spring on Grand Island presented by the late highly esteemed Surveyor-General, Simeon De Witt, labelled "Sulphuric acid." On testing this water I found it to redden litmus paper, and to give a dense white precipitate with muriate of barytes. The specific gravity is 1.00254. The amount of saline matter which it contains is, therefore, exceedingly small.

Springs of Erie county.—About four miles from Buffalo, upon the Indian lands, is the Seneca spring, long known by the name of the Deer Lick. There are several of these springs, issuing from the opposite sides of the stream upon which they are situated, and a large quantities of sulphuretted hydrogen gas is continually evolved from them. According to Prof. Charles U. Shepard, the water of the Seneca spring is strongly sulphureous, but is free from uncombined carbonic acid; and contains notable quanities of the carbonates of lime, magnesia and soda, together with the sulphate of lime.*

Sulphur Springs of Chautauque county.—In the county of Chautauque, sulphur springs are of frequent occurrence, and apparently have some connexion with the issues of carburetted hydrogen gas, for which that county has become so celebrated. In the village of Fredonia, many springs of this kind have been discovered, but they are said to lose their sulphureous character in a short time. This, however, is not the case with those found elsewhere. On the shore of Lake Erie, about a mile east of Van Buren harbor, a spring highly charged with sulphuretted hydrogen issues out of the slate rock, nearly on a level with the lake. The water is cold and clear, but the quantity is not very abundant. The specific gravity is 1.00193 at 60° F. and it contains minute portions of the carbonate of lime, sulphate of lime and sulphate of soda.

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* Silliman s Journal, XX, 157.

Another spring of a similar kind occurs near the sandstone quarries at Laona, a mile south of Fredonia, and others are also found in the town of Sheridan, a mile and a half from Lake Erie.

Springs of the Southwestern counties.—We have accounts of numerous sulphuretted springs in the other counties bordering on the State of Pennsylvania. In Steuben county, Campbelltown, a village in the northwestern part of the town of Campbell, has a spring of this kind near it, which is said to be remarkably pure, and to emit a stream of air which may be inflamed when confined. And similar springs occur in the towns of Jasper and Urbana, in the same county.*

Tompkins county has a sulphur spring, in the town of Dryden, ten miles east of Ithaca, which has acquired some celebrity, and another on Six Mile creek, a mile or two south-east of Ithaca.†

In the town of Tioga, in the county of the same name, is a sulphuretted spring, and a similar one occurs in the southwest corner of Barton, on the east bank of the Chemung river; the waters of neither have been analyzed.‡

Finally, in Cortland county, such springs are said to have been discovered; and in the county of Chenango, near the south line of the town of McDonough, is Spee's Spa, a sulphur spring much frequented, and at which is a large house for the accommodation of visiters. Another, also much resorted to, is situated two miles from the village of Norwich; and there is still another in the town of Pharsalia in the same county.

It was my intention to have added to this general view of the sulphuretted springs of our State, some remarks concerning the origin of the sulphuretted hydrogen gas thus largely and extensively evolved: but I have only space to repeat, what has been already suggested, that the cause ordinarily assigned, viz. the decomposition of the sulphuret of iron, seems to me to be wholly inadequate, and that we must refer it to some agency far more general and effective.

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* Gordon's Gazetteer.

† Medical Topographical Report of Tompkins county, in the Transactions of the New-York State Medical Society, III. 25.

‡ Medical Topography of the county of Tioga, in the Transactions of the New-York State Medical Society, III. 151.

PETRIFYING SPRINGS.

The history of petrifying springs affords a fine illustration of the intimate relations which exist between the researches of the chemist and the geologist. For whatever difference of opinion may prevail concerning the true theory of the petrifying process which in many situations is daily going on, there is no doubt of the general fact, that chemical agencies are largely concerned in it.

The explanation ordinarily given of the formation of travertin or calcareous tufa, stalactites, &c. is sufficiently simple, and may be easily comprehended. The water in certain springs holds in solution considerable quantities of carbonate and sulphate of lime, and occasionally of silica, which are deposited when the water comes into contact with the air. This process is well exemplified in the formation of those small stalactites which are often found attached to the arches of aqueducts on our canals. The water contained in these aqueducts percolates through the limestone of which they are constructed, and thus becomes charged with carbonate of lime, which it again deposits when exposed to the air.* Many localities occur in this State, where extensive calcareous incrustations are formed in a similar manner. There is a very interesting exhibition of this kind near Camillus, in Onondaga county, where, below the marly clay and beds of gypsum, these calcareous incrustations are found, which are both fibrous and crystallized—sometimes existing in regular strata, and at others forming the walls of cavities, of various figures and dimensions.

Simple as the explanation of these phenomena may seem, when it is known that water in its natural state always contains air and carbonic acid, which enable it to hold in solution a small quantity of carbonate of lime, it is not so easy to comprehend all the circumstances which attend the process of petrifaction, or the conversion of vegetable into stony matters; for it is to this only that our attention will at present be directed. That the most delicate parts of vegetables should be replaced by carbonate of lime, or silica, without any alteration of their form, is certainly one of the most curious operations going on in the laboratory of nature. I shall therefore offer no apology for presenting a brief notice of these springs, and a few suggestions concerning the mode in which they produce these singular results.

As might be inferred from what has already been said, these petrifying springs are most common in limestone regions. They therefore abound in the western parts of the State, although they are by no means confined to them.

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* The stalactites pendant on the arches of the aqueducts of our canals, have been called nitrate of lime; but all those which I have examined are pure carbonate of lime.

Calcareous tufa is deposited from the water of springs near Whitehall, in Washington county, and it is also to be met with in the counties of Franklin and St. Lawrence; as, for example, near the Chateaguay Corners, and also about four miles from the village of Gouverneur.

In Schoharie county, tufa is found in great abundance on the sides of the mountains, from five to fifteen feet in depth, containing fine impressions of leaves, and covering grasses and mosses with incrustations so delicate as to preserve distinctly every fibre. And here it is to be remarked, that old deposits are covered with vegetable loam, on which shrubs and trees are growing.*

A very remarkable deposit of a similar kind is found near the head of the Otsquaga creek, in Herkimer county. It proceeds from the slate rocks, which are either the upper layers of greywacke or the calciferous slate. The calcareous tufa which proceeds from these rocks contains the impressions of numerous plants of the same species which are now growing in the vicinity. There is a single mass on the bank of the creek about three hundred feet long and fifty feet wide, and from ten to forty feet thick. It is very irregular in its form, and near the north end it is cavernous. Several rude apartments may be entered, which present curvilinear sides and irregular conical columns. At the south-western termination of this extensive deposit, about a mile south of the cavern, there are the tufa petrifactions of six logs, which stand obliquely against a side hill. They are still very perfect, (not having been often visited) retaining the forms of the shelly scales of the bark, the knots, &c.†

Probably the most noted of the springs which are now under consideration, are those found in the vicinity of Chittenango, in Madison county. At the base of a hill, the rocky strata of which contain a large proportion of carbonate of lime, calcareous deposits and incrustations of various kinds are to be found. These have been formed, and are probably daily in the act of formation, by the agency of the waters which continually percolate through this hill of porous limestone. From this locality, specimens may be obtained of leaves, moss, wood, &c, in all states, from that of the proper vegetable, to that of the hard calcareous substance in which scarcely a trace of vegetable matter can be detected.

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* See a paper on the Geology and Mineralogy of Schoharie County, by John Gebhard, Esq. Silliman's Journal, XXVIII. 172.

† Canal Rocks, page 128.

Similar deposits and petrifactions are very frequent in the county of Onondaga. At the base of a hill near Syracuse large masses of tufa are to be seen. More extensive deposits occur in the towns of Marcellus and Camillus; and here, trunks of trees and aggregates of leaves and roots converted into pure carbonate of lime are not uncommon.

Calcareous tufa is also found in great abundance near the Genesee falls at Rochester, in Cayuga county; near Ithaca in Tompkins; also near the falls of Niagara, and in various other places which it is scarcely necessary to particularize. At the Niagara and Genesee falls, large masses of moss are found incrusted with carbonate of lime, evidently caused by the carbonate of lime held in solution by the waters which are continually passing over them. These incrustations, therefore, are undoubtedly to be referred to causes now in operation.

The vicinity of Chittenango probably affords the best opportunity for studying the circumstances attending the conversion of vegetable matter into carbonate of lime. And for the purpose of arriving at some conclusions with regard to these, I subjected to analysis various portions of the tufa or petrified vegetable matter, together with some of the water which issued from a side-hill and appeared to be the agent concerned in the petrifying process.

The petrified wood was found to consist almost entirely of carbonate of lime, with very minute and variable portions of silica, alumina, and oxide of iron. As I have before remarked, in some specimens not a trace of vegetable matter was discoverable, while in others its presence could be easily detected. It is evident, therefore, that while the structure of the plant remains entire, the vegetable matter by the petrifying process is wholly or in a great measure, replaced by the carbonate of lime.

From the side-hill at the base of which these specimens of petrified vegetables occur, springs of water every where burst out. The superincumbent rock contains a large proportion of carbonate of lime, and the sulphate of lime is also found in beds enclosed within it. The composition of this water is what might be expected from the nature of the strata through which it passes. The water from one of these springs had a faint smell of sulphuretted hydrogen, and contained a little carbonic acid. In 1000 parts, I found

Solid matter, consisting of carbonate and sulphate of lime, and sulphate of magnesia,...............	1.94
Water,..	998.06
	1000.00

It is a curious fact, that in this water the sulphate of lime is in the largest proportion, while no trace of it can be discovered in the tufa. If this be true of all these springs, the sulphate of lime must be converted into a carbonate at the moment of its deposition, or soon after that deposition has taken place.

It has been conjectured that the conversion of vegetable into mineral matter is intimately connected with the phenomena of slow putrefaction, and that these must be studied whenever we attempt to reason on the conversion of fossil bodies into stone.*

In many of the specimens found in Chittenango, the petrified leaves, apparently of the beech, are much thicker than those which have not undergone this change. And from the prominence of the midrib and nerves, I am induced to think that the change commenced with the decay of the fleshy part of the leaf, and was completed by that of the more solid or woody portions.

If the composition of this petrifying water has been correctly determined; it contains sulphate and carbonate of lime, each of them probably held in solution by a slight excess of acid. Now vegetable matter consists essentially of carbon, hydrogen and oxygen, the two latter being gaseous, while the carbon is solid and gives form to the different parts of the plant. May not, then, the decomposition of the vegetable be promoted by this sulphuric acid, which combines with the hydrogen and oxygen, or water of the vegetable, and leaves the carbon? And may it not be the carbon remaining after the action of the acid, which causes the change of the sulphate into the carbonate of lime, and which at the same time also abstracts a portion of the oxygen in the carbonic acid, which holds the carbonate of lime in solution, and thus causes the deposition of the latter substance?

If these questions are answered affirmatively, I think we can account for the fact, so apparent in examining these petrifactions, that oftentimes the most perishable portions of the plants are preserved; for the carbon is the solid matter of the vegetable, and is that constituent to which it owes its form. But this, according to the suggestion here made, leaves its state of carbon only to be converted into carbonate of lime, and this last being also solid, the vegetable form is preserved.

I have, perhaps, occupied more space with this subject than may be thought proper. But the process is one of great interest, and the evidences of the change wrought by it, are found abundantly scattered through our State. The theory which has been suggested as applicable to the particular locality above described, requires a more full examination than the present occasion would warrant, and I shall therefore leave for another opportunity its further elucidation.

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* Lyell's address to the Geological Society of London, 1837.

This is the most complete account which I can at present give of the mineral springs of the State of New-York. Although their number is already large, there is no doubt that it will be greatly increased before the completion of the Survey now in progress. It will be observed, that even of those now known, only a small proportion have been examined with that care which is necessary, in order to determine their chemical composition. Whether the investigations and analysis thus commenced, shall extend to all the more important springs of the State, must be determined by those under whose authority this department has been instituted.

In my next annual communication I hope to present an account of the minerals found in this State, (other than those noticed in my former report) which are used in the arts.

I have the honor to be,
Your obedient servant,
LEWIS C. BECK.

New-York City University, January 20th, 1838.

	do	Two or three miles west of Sa
	Petrifying, ...	Calcareous tufa is abundant in t this county, ...
Schoharie,........	Sulphureous,.............	Several near the village of Lees
	Chalybeate,..............	Near the preceding,........
	Petrifying, ...	Calcareous tufa is found in abu
Seneca,..........	Sulphureous ?	In the village of Waterloo,....
Steuben,.........	do	Near Campbelltown, a village in bell,................
	do	At the post-office in the town o
	do	In the town of Urbana, ...
Tioga, ...	do	In the town of Tioga,.......
	do	In the SW part of the town of mung, ...
Tompkins, ...	do	In the town of Dryden, 10 mil
	do	On Six Mile creek, a mile or tw
	Petrifying, ...	Near the village of Ithica,....
Wayne, ...	Brine,...................	In the town of Galen,......
	do	In the village of Clyde, ...),......
	do	Near the head of Little Sodus
Washington,......	Petrifying, ...	Springs in various parts of the
Westchester,......	Sulphureous,.............	Chappequa Spring, three and a

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CATALOGUE

Of the Mineral Springs in the State of New-York, hitherto known, with their composition as far as determined.

County.	*Kind of spring.*	*Particular locality.*	*Geological situation and height above tide.*	*Temperature.*	*Kind of gas evolved.*	*Total amount of solid matters in a pint.*	*Nature of the more abundant and active ingredients.*	*Authority.*
Albany,	Acidulous saline chalybeate,	Near Boyd's Brewery, Ferry-street, Albany,	Slate,	51° to 52° (Meade,)	Carbonic acid, 28 cub. inches in a pint,	75 grains,	Chloride of sodium, carbonates of lime, magnesia and iron,	L. C. Beck.
	Carburetted hydrogen gas,	do do do	do		Carburetted hydrogen,			
	Sulphureous,	do do do	do		Sulphuretted hydrogen,			
	do	Wendell's Hollow, near the city,	do		do do			
	do	Town of Coeymans, near the landing,			do do			
	do	Town of Guilderland, near W. McKown's,			do do			
	do	Town of Watervliet, near Gen. Van Rensselaer's,	Slate,		do do			
	Petrifying,	do do do	do		Carbonic acid, in minute quantity,			
Broome,	Brine spring,	Town of Lisle, near Chenango Forks,			do		Chloride of sodium,	
Cayuga,	Brine,	Several near the village of Montezuma,	Marly clay, 380 ft. above tide,	50°,	do	790.70 grains,	do of sodium, magnesium & calcium, carbonate & sulphate of lime,	L. C. Beck,
	Sulphureous,	Town of Sennet, two miles north of Auburn,			Sulphuretted hydrogen,			
	do	Four miles west of Auburn, on the farm of Nelson Van Ness,	Limestone, 650 ft. above tide,		do do 1.5 cub. inches,	19.2 grains,	Sulphate of lime and magnesia, chlorides of sodium and magnesium,	J. R. Chilton.
	do	Spring Mills, on the eastern shore of Cayuga Lake,			do do			
	Chalybeate,	Town of Sennett, five miles north-west of Auburn,			Carbonic acid,			
	Petrifying,	Town of Sempronius,			do			
Chautauque,	Inflammable gas,	In and near the village of Fredonia,	Bituminous slate, 692 ft. above tide,		Carburetted hydrogen,			
	do	In Lake Erie, near Van Buren harbor,	Slate, 565 ft. above tide,		do do			
	do	At Portland harbor,			do do			
	do	Town of Sheridan, and in various other parts of the county,			do do			
	Sulphureous,	A mile east of Van Buren harbor,	Bituminous slate, 565 ft. above tide,		Sulphuretted hydrogen,			
	do	Near the village of Laona,	do sand stone, 806 ft. do		do do			
	do	Several in and near Fredonia,	do slate, 692 ft. do		do do			
Chenango,	do	Shee's Spa in the town of McDonough,			do do			
	do	Two miles from the village of Norwich,			do do			
	do	Town of Pharsalia,			do do			
Clinton,	do	Town of Beekman,			Sulphuretted hydrogen & carbonic acid,			
Columbia,	Thermal spring,	Lebanon,	Transition limestone, &c.,	73°,	Nitrogen and atmospheric air,	1.25 grains,	Chlorides of sodium and calcium, sulphate and carbonate of lime,	Meade.
	Sulphureous,	City of Hudson,	Slate, 150 ft. above tide,					
Cortland,	Brine,				Carbonic acid?		Chloride of sodium, &c.	
	Sulphureous,				Sulphuretted hydrogen,			
Delaware,	Brine?	About four miles from the village of Delhi,	1,384 ft. above tide,		Carbonic acid?		do do	
Dutchess,	Inflammable gas,	In the town of Northeast, from the bottom of a lake,			Carburetted hydrogen,			
Erie,	Sulphureous,	On Grand Island,	570 ft. above tide,		Sulphuretted hydrogen,			
	do	Several on the Indian land, four miles west of Buffalo,			do do		Carbonates of lime, magnesia and soda, sulphate of lime,	C. U. Shepard.
Franklin,	Nitrogen,	Half a mile east of Chateaugay corners,			Nitrogen,			Emmons.
	Petrifying,	do do			Carbonic acid,		Carbonate of lime,	
Genesee,	Sour springs,	Near North Byron,					Sulphuric acid with lime, alumine and oxide of iron,	L. C. Beck.
	Sulphureous,	do			Sulphuretted hydrogen,			
	Brine,	In the town of Elba, 8 miles northwest of Batavia,					Chloride of sodium, &c.	
Greene,	Petrifying,	Many of the streams deposit extensive beds of calcareous tufa,					Carbonate of lime,	
Herkimer,	do	On the Otsquago creek, in the town of Stark,					do do	
	Sulphureous,	Ten miles south of Fort Plain,			Sulphuretted hydrogen,			
Lewis,	do	Near Martinsburgh, and elsewhere in the county,	Transition limest'e, 800 ft. above tide,		do do			
Livingston,	Brine,	Town of York, near Hall's saw-mill,					Chloride of sodium, &c.	
	Sulphureous,	At Caledonia village, a large spring slightly impregnated with gas,			Sulphuretted hydrogen,			
	do	Several near West Avon,	Calciferous slate,	51°,	do do & carbonic acid,	17.08 grains,	Sulphates of lime, magnesia and soda, chloride of sodium and carbo- [nate of lime,	Prof. Hadley.
Madison,	do	In the valley of the Chittenango creek, a mile south of the village of the same name, (Yates' spring,)	do 440 ft. above tide,	49°,	do do do	15.43 grains,	Sulphate of lime & magnesia, carbonate of lime & chloride of sodium,	L. C. Beck.
	do	In same valley, two miles S of Chittenango, (White Sulphur spring,)	do 450 do	48°,	do do do	12.66 grains,	do do do	do
	Petrifying,	Several issuing from side hill in the immediate vicinity of Chittenango,	do		do do do		Sulphate and carbonate of lime,	do
	Brine,	Town of Lenox, near the Erie canal,	425 ft. above tide,				Chloride of sodium, &c.	
Monroe,	do	In the town of Penfield, within a mile of Lake Ontario,	Red sandstone,				do do	
	do	On the Irondequoit bay, from two to three miles from Lake Ontario,	do				do do	
	do	In the town of Greece, nine miles northwest from Rochester,					do do	
	Inflammable gas,	Near the mouth of Genesee river,						
	Sulphureous,	Longmuir's, in the city of Rochester,	Calciferous slate, 506 ft. above tide,	52°,	Sulphuretted hydrogen,	14.99 grs.	Sulphates of lime and soda, chloride of sodium, & carbonate of lime,	L. C. Beck.
	do	At the village of Ogden, in the town of the same name, half a mile south of Spencer's basin,			do do			
	do	Several in the towns of Gates, Mendon and Pittsford,			do do			
	do	Caledonia spring, in the town of Wheatland, forming a large stream slightly impregnated with gas,			do do			
New-York,	Saline,	Cliff-street, New-York city,			Carbonic acid and atmospheric air,	18.78 grs.	Carbonate of lime and magnesia, sulphates of soda and magnesia, [chloride of sodium,	G. Chilton.
Niagara,	Inflammable gas,	At Gasport, in the town of Royalton, six a half miles E of Lockport,	505 ft. above tide,		Carburetted hydrogen,			
	Petrifying,	At Catlin's cave, half a mile below the falls. Calcareous tufa is found every where under the Falls,	Limestone,				Carbonate of lime,	
	Sulphureous,	About a mile above the Falls,	Limestone, 570 ft. above tide,		Sulphuretted hydrogen,			
	do	On the bank of the Niagara, about two miles below the Falls,	do		do do			
		In the northern part of the town of Pendleton, near the canal,	do 565 ft. above tide,		do do			
Oneida,	Brine,	Near Vernon centre,					Chloride of sodium, &c.	
	do	Ten miles west of Vernon village,					do do	
	Inflammable gas,	A mile west of Vernon village, seventeen miles west of Utica,			Carburetted hydrogen,			
	do	About half a mile northeast of the village of Hampton,			do do			
	Sulphureous,	In the village of Augusta, eighteen miles southwest of Utica,			Sulphuretted hydrogen,			
	do	Near the village of Paris, in the town of the same name,			do do			
	do	Half a mile southwest from the village of Verona, 14 miles nearly west of Utica,			do do	107.25 grs.	Chlorides of sodium, calcium and magnesium, and carbonate of soda,	Dr. J. Noyes.
	do	In the town of Paris, nine and a half miles south of Utica,			do do			
	Saline,	About half a mile northeast of the village of Hampton, town of Westmoreland, called "Halleck spring."			Carburetted hydrogen & carbonic acid,	100.00 grs.	do do do and sulphate of lime,	do
Onondaga,	Brine,	At Syracuse, Salina, Geddes and Liverpool,	Marly clay, 390 ft. above tide,	50° to 51°,	Carbonic acid,	From 1115 grs. to 1201 grs.	Chlorides of sodium, calcium and magnesium, sulphate and carbonate [of lime,	L. C. Beck.
	do	Two miles south of Syracuse; about 25 or 30 feet above the level of the Onondaga lake at Salina,			do		Chlorides of sodium, &c.	
	Sulphureous,	Between the branches of Limestone creek, near the village of Manlius,			Sulphuretted hydrogen,			
	do	In the town of De Witt, three miles northeast of Syracuse, known by the name of the "Messina spring,"	Limestone,	50°,	do do	13.09 grs.	Carbonate & sulphate of lime, sulph. of magnesia, & chlor. of calcium,	do
	do	On the ground of Mr. E. F. Wallace, near the village of Syracuse,	390 ft. above tide,	50°,	do do & carbonic acid,	133.64 grs.	Chlorides of sodium, calcium & magnesium, carbonate & sulph. of lime,	do
	do	Near the State well at Salina,		50°,	do do do	186.41 grs.	Chloride of sodium, &c. &c.	do
	do	Lake Sodom, two miles east of Manlius centre,			do do			
	Saline,	About a mile west of the village of Canastota,	420 ft. above tide,				Chloride of sodium and magnesium, and sulphate of lime,	Mr. C. A. Spencer.
	Chalybeate,	At Foote's settlement,			Carbonic acid,			
	do	In the town of Van Buren,						
	Petrifying,	On the banks of the Otisco outlet, in the town of Marcellus,			Carbonic acid,		Carbonate of lime,	
	do	Near Syracuse, Onondaga, Manlius, Camillus, &c., where calcareous tufa is very abundant,						
Ontario,	Inflammable gas,	Bristol Hollow, town of Bristol, nine miles WSW of Canandaigua,			Carburetted hydrogen,			
	do	Federal Hollow, in the town of Middlesex, a mile from Rushville, and about 21 miles from Palmyra,			do do			
	do	On both sides of Canandaigua Lake, within three miles of the village,			do do			
	do	In East Bloomfield, and in the town of Richmond,			do do			
	Sulphureous,	Several in the town of Phelps, about 11 miles NW of Geneva, known by the name of the "Clifton Springs,"			Sulphuretted hydrogen,			
	do	On the banks of the outlet of Canandaigua Lake,			do do			
Orange,	do	About two and a half miles from the village of Newburgh, on the farm of Dr. M. Higby,	About 150 feet above tide,		do do			
	do	On the farm of G. Clinton, Jr. Esq. in the town of New-Windsor,			do do			
	Chalybeate,	On the top of Shawangunk mountain, in the town of Minisink,			Carbonic acid?			
Orleans,	Brine,	In the town of Murray, near Sandy-Creek,			do		Chloride of sodium, &c.	
	do	In the town of Ridgeway, between the Erie canal and the Ridge road,			do		do do	
	do	Near Holley village, on the canal,	500 ft. above tide,		do		do do	
Oswego,	do	In the towns of Constantia, Richland and Sterling,			do		do do	
	do	In the town of Hannibal, a mile NE of Kinney's Corners, called "Burr's Salt Works,"			do		do do	
	do	In various parts of the town of Hastings; one four miles west from Central Square; another two miles west of this, and a third at Central Square,			do		do do	
Otsego,	do	At Salt Springville, partly in this and partly in Montgomery county,			do	From 250 to 290 grs.,	do do	
	Sulphureous,	In the town of Richfield,			Sulphuretted hydrogen,			
	do	Near Cherry-Valley,	1,335 ft. above tide,		do do			
Rensselaer,	do	Near the village of Bath, opposite to Albany,	Slate, 20 to 30 ft. above tide,		do do			
	do	Near Greenbush, opposite to Albany, and near the seat of Mrs. Genet, three miles south of Albany,	Slate,		do do			
	do	At the north end of the city of Troy, and in various other parts of the county,	20 to 30 ft. above tide,		do do			
	Nitrogen,	In the SE corner of the town of Hoosick, six miles SE of the village of Bennington, Vt.			Nitrogen,		Chlorides of sodium and calcium,	
Richmond,	Chalybeate,							
St. Lawrence,	Sulphureous,	On the banks of the river Racket, about a mile from the village of Massena. Several others occur on the same stream,			Sulphuretted hydrogen,			
	Petrifying,	Four miles NW of the village of Gouverneur,			Carbonic acid,		Carbonate of lime,	
Saratoga,	Acidulous saline chalybeate,	Congress Spring, in the village of Saratoga Springs,		50°,	do & atmos. air, 39.75 cu.in.	74.78 grains,	Choride of sodium, carb's of soda, magnesia, lime, iron, iodine, bromine,	Dr. J. H. Steel.
	do do	Columbian Spring, 15 or 20 rods SW from the Congress,		50°,	do do 34.75 do	50.91 grains,	do do do do	do
	do do	Washington Spring, 50 rods SW from the preceding,		50°,	do do 33.66 do	54.87 grains,	do do &c. iodine,	do
	do do	Hamilton Spring, 50 rods NE from the Congress,		50°,	do do 40.00 do	57.54 grains,	Composition similar to the preceding,	do
	do do	Flat Rock Spring, about 100 rods NE of the Hamilton Spring,		48°,	do do 36.75 do	34.95 grains,	do do	do
	do do	High Rock Spring, about 100 rods north of the preceding,		48°,	do do 38.62 do	43.21 grains,	do do	do
	do do	President Spring, about 30 rods NE of the High Rock,			Carbonic acid,		do do	
	do do	Red Spring, from 60 to 70 rods NE of the President Spring,			do		do do	
	do do	Barrel Spring, near the High Rock; Walton Spring, in rear of the Columbian Hotel; Monroe Spring, 15 or 20 rods N of Flat Rock,			do		do do	
	do do	Ten Springs, about a mile east of the High Rock,			do		do do	
	do do	Ellis Spring, about two miles in a SW direction from Congress Spring,			do		do do	
	do do	Several in the town of Saratoga, about 10 miles SE of the Congress Spring, called the Quaker Springs,			do		do do	
	do do	Sans Souci Spring, in rear of the Sans Souci, in the village of Ballston Spa,	Slate,	50°,	do		do do	
	do do	United States Spring, a short distance from the preceding,	do	50°,	do and atmospheric air,	60.82 grains,	Chloride of sodium, carb. of lime, magnesia & soda, sulphate of soda,	L. C. Beck.
	do do	Public Well, near the centre of the village of Ballston Spa,	do	50°,	do do		Composition similar to the preceding,	
	do do	Washington Spring, in the street, a few rods south of the former,	do	50°,	do do		do do	
	Acidulous chalybeate,	Park Spring, in rear of the Village Hotel, Ballston Spa,	do	50°,	do do		do do but contains a larger proport'n of oxide of iron,	
	do do	Fulton Spring, Ballston Spa, 19 feet from the United States Spring,	do	50°,	do do		do do do do	
	Sulphureous,	Franklin Spring, 12 feet from the United States Spring,			Sulphuretted hydrogen,			
	do	On the eastern bank of Saratoga Lake, about a mile south of Snake Hill,			do do			
	do	Two or three miles west of Saratoga Springs,			do do			
	Petrifying,	Calcareous tufa is abundant in the vicinity of several of the springs in this county,						
Schoharie,	Sulphureous,	Several near the village of Leesville, in the town of Sharon,			Sulphuretted hydrogen,			
	Chalybeate,	Near the preceding,			Carbonic acid,			
	Petrifying,	Calcareous tufa is found in abundance in various parts of the county,						
Seneca,	Sulphureous?	In the village of Waterloo,						
Steuben,	do	Near Campbelltown, a village in the NWern part of the town of Campbell,			Sulphuretted hydrogen,			
	do	At the post-office in the town of Jasper,			do do			
	do	In the town of Urbana,			do do			
Tioga,	do	In the town of Tioga,			do do			
	do	In the SW part of the town of Barton, on the east bank of the Chemung,			do do			
Tompkins,	do	In the town of Dryden, 10 miles east of Ithaca,			do do			
	do	On Six Mile creek, a mile or two SE of Ithica,	417 ft. above tide,		do do			
	Petrifying,	Near the village of Ithica,					Carbonate of lime,	
Wayne,	Brine,	In the town of Galen,	About 450 ft. above tide,		Carbonic acid,	84.24 parts of saline mat- [ter in 1,000 of brine, Requires 140 gal. for bush. salt	Chlorides of sodium, calcium and magnesium, sulphate and carbonate [of lime,	G. Chilton,
	do	In the village of Clyde,			Carburetted hydrogen & carbonic acid,			
	do	Near the head of Little Sodus bay,			Carbonic acid,		Chloride of sodium, &c.	
Washington,	Petrifying,	Springs in various parts of the county,			do		Carbonate of lime,	
Westchester,	Sulphureous,	Chappequa Spring, three and a half miles east of Sing-Sing,			Sulphuretted hydrogen,			

REPORT

Of T. A. Conrad on the Palæontological Department of the Survey.

In conformity with instructions from the Executive, I beg leave, as Palæontologist, to submit the following

REPORT.

As in my opinion, it is of great importance, both in a scientific and practical point of view, to ascertain as early as possible the geological age of the rocks of New-York, and as this can be done in a satisfactory manner only by comparison of the organic remains with those of other countries, where the formations have been accurately classified, I have drawn up tables of the fossils principally with a view to show how many species are common to the rocks of Europe and America. Our works of reference are as yet, unfortunately, few, but when this difficulty is removed I confidently expect to be able to discover in our fossls nearly all the characteristic species of the Lower Transition or Silurean System of Europe.

There are some geologists who wish to establish in every island and continent, a peculiar system of rocks, independent of other remote countries; but when we consider that in the earlier eras of our planet, the temperature was uniform and the seas comparatively very shallow; would we not expect to find all the organic remains of such periods to consist chiefly of one group of species over the whole globe, especially when we find the flora of the Carboniferous era to have been every where nearly the same? Are not rocks of the Oolitic group in South America, the Cretaceous, and even the Eocene of North America, mere extensions of European systems, deposited in seas of the same periods, and containing the same groups of shells? Deeper oceans, and greater variation of temperature have cast more uncertainty over the upper Tertiary formations, but the Transition affords us the converse of this proposition; greater uniformity of temperature, a more perfect identity of organic remains, and rock masses of more uniform character. That the sea of one of these ancient eras was shallow, is proved not only by its universality, but by the ripple marks and fucoides which every where pervade the strata. A negative evidence is also supplied in the nature of the fossils. Dr. Buckland has shewn how admirably the complicated chambers, and the exterior surface, of the Ammonites were constructed, to resist the pressure of deep water. But shells of this genus were not created until more profound seas had resulted from changes in the configuration of the earth's surface, subsequent to the deposition of the coal formations. The Goniatite which has a plain exterior and septa simply angulated, is unknown in that part of the Transition we have termed the Trenton group; and in the upper part of the series it is among the rarest of the univalves, abounding only in the Carboniferous epoch. The Cephalapods, which flourished in the lower transition, were reduced to the simpler structure of the genera *Cyrtoceras*, Grthoceras, and a few kindred forms with plain arched septa like the Nautilus. There is also reason to believe that the Brachiopods of the Transition so different from the prevailing form of the superior strata which constitutes the genus Terebratula, were, unlike the latter, denizens of very shoal water. Immense numbers lived and were entombed with the remains of terrestrial plants on the margins of islands in the Carboniferous epoch. The bituminous shale of the coal measures is in some places stored with a species of *Producta* with long filiform spines, all the specimens having the two valves in their natural position, and the spines broken off from the shells simply by pressure of the superincumbent strata. They were never subjected to the action of a stormy surf, and yet land plants grew in the vicinity of the living shells; hence we infer a quiescent state of the waters around the islands of the transition eras. But one exception has been noticed, which occurs at Rochester, in a thin layer of limestone full of broken *Pentamera;* in other places single valves of bivalves occur, but the entire shells are so remarkably abundant, that whatever may have been the force of currents originating the breccias and conglomerates, the waters were remarkably quiescent during the deposition of shales and limestones.

As the student of geology has generally some difficulty in understanding the fossil Brachiopodous genera, it may be well to observe that we shall in our reports adopt the following names and divisions:

Producta, has one valve convex, the other concave, no cardinal area nor perforation under the beak.

Leptæna, has one valve convex, the other concave; a narrow cardinal area and a small triangular perforation. The form is generally the segment of a circle.

Delthyris, has both valves convex; a cardinal area and triangular perforation. The shell is often much produced, forming a long straight hinge line, and the shape is generally triangular.

Orthis, has no cardinal area; the valves slope from the apex, and there is a narrow perforation under the beak.

Atrypa, has the valves sloping from the apex, no cardinal area, and the beak of one valve is bent over the apex of the other; there is no perforation.

The genus *Producta* contains very few species in the lower part of the silurean system, and they have little diversity of form. The amount of species gradually increases in the upper strata, and finally they exhibit their maximum in number of species and individuals in the carboniferous system. The four Brachiopodous genera I have described, soon disappeared after the Carboniferous epoch, and the true Terbratula were then, for the first time, called into existence in great profusion.

The course of our investigations having resulted in the conviction, that the rocks of New-York, with the exception of the upper part of the Catskill mountains, terminate with the upper Ludlow rocks of Murchison; we have an additional argument in favor of the universal nature of ancient formations, and the contemporaneous deposition of our coal strata with those of Europe. This correspondence Professor Eaton has inferred from the identity of the fossil flora, but the proof does not end here. While the same kind of plants flourished upon the islands where now are the continents of Europe and America, the same species of shells existed in the waters which girded them. Thus in the ironstone layers beneath the coal of Tioga county, the common European bivalve *Producta scabricula* abounds just as it does at Coalbrookdale in the same rock. Specimens from both countries, if accidently mixed, could not be separated by any mineral or conchological difference. The species which we have identified with those of Europe are the following:

Delthyris trigonalis, Sowerby,
cuspidatus, S.
Producta, analoga, Phillips.
*Scotia, S.

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* Those species marked with an asterisk have been erroneously referred to the "Primary System." Vide Encyc. Metropolitana; article Geology, p. 575.

Producta *sulcata, S.
*hemispherica, S.
scabricula, S.
*Euomphalus catillus, S.
Goniatites Henslowi, S.
minuta, S.
Calamopora polymorpha, Goldfuss.

Limestone containing these fossils is not of frequent occurrence in Pennsylvania or Ohio; the shells being chiefly embedded in bituminous shale and ironstone and, in Ohio, in chert. It is only west of the Mississippi that the mountain limestone becomes an extensive and important rock.

1. The first group of strata, in the descending order, below the sandstone which contains impressions of terrestrial plants, consists of rocks which are seldom calcareous, and appear to be equivalent, as mentioned in my report of last year, to the Ludlow rocks of Murchison. In Mr. Vanuxem's report will be found an accurate account of the characteristic species of each group.

Organic remains of the first group.

Radiaria.	*European localities*
Cyathocrinites pinnatus, G.	Eifel.
Euryale annulatum, Dekay.	
Testacea.	
Posidonia lirata, C.	
Pterinea fasciculata, G	Nassau.
concentrica, C.	
bisulcata, C.	
appressa, C.	
punctulata, C.	
cuneata, C.	
triqueter, C.	
Avicula tuberculata, C.	
Lima macroptera, C.	
Monotis princeps, C.	
Orbicula ovalis, C.	
Delthyris undulata, S	Arran.
macroptera, G	Coblenz.
incilis, C.	
Producta spinulosa, S	Lithlingow.

Testacea.	*European localities.*
Orthis crumena, S	Eifel.
Atrypa concentrica, Br	Tournay.
Conularia undulata, C.	
Cyrtoceras maximus, C.	
Goniatites punctatus, C.	
Orthoceras constrictum, C.	
Crustacea.	
Eurypterus remipes, Dekay,	Midlothian.
Cryphæus Boothii, Green.	
Calymene bufo, var. rana, Green.	
Lerowi, Green.	
*Dipleura Dekayi, Green,	
Asaphus tetragonocephalus, Green.	

2. The second group consist chiefly of limestone. Two intercalated strata of sandstone occur, characterized by a species of fucoides, which we have named *F. Cauda-galli.* No other organic remain is found in this rock. The group is undoubtedly equivalent to the celebrated Dudley limestone, the Wenlock and Dudley rocks of Murchison.

ORGANIC REMAINS OF THE SECOND GROUP.

Polyparia.	*European localities.*
Catenipora escharoides, G.	
labyrinthica, G.	Groningen.
Calamopora fibrosa, G.	Eifel.
favosa, G..	
basaltica, G.	
Columnaria alveolata, G.	
Cyathophyllum helianthoides, G.	Eifel.
ceratites, G.	do
turbinatum, G.	do
plicatum, G.	
vermiculare, G.	do
Strombodes pentagonus, G.	do
Syringipora verticellata, G..	
Anthophyllum denticulatum, G.	
Radiaria.	
Cyathocrinites pinnatus, G.	Eifel.
Apiocrinites.	

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* This trilobite has been erroneously supposed to occur at Lockport.

Testacea.	*European localities.*
Pileopsis tubifer, S.	near Clithero.
compressa, G.	Eifel.
ventricosa, C.	
vetusta, S.	Plymouth.
Pentamerus Knightii, S.	Yeo Edge, Downton, Eifel.
Atrypa concentrica, Brown,	Tournay.
affinis, S.	Dudley.
Leptæna depressa, S.	do
punctulifera, C.	
indenta, C.	
unguiformis, C.	
Delthyris resupinata, S.	Dovedale.
pachyoptera, G.	
cycloptera, C.	
bilobata, C.	
Peterinea alæforme, S.	Eifel.
Conularia quadrisulcata, S.	Gloucestershire.
Orthoceras inflatum,	Eifel.
Crustacea.	
Cytherina,	
Calymene bufo, Green,	Coalbrookdale.
platys, G.	
anchiops, G.	
Asaphus selenurus, Eaton.	
laticostatus, G.	
micrurus, G.	

3. The third group has been termed "Calciferous slate" by Eaton. It is a gray limestone shale, containing all the gypsum beds of the State. Organic remains are very rare, except on the Genesee river, where no gypsum occurs. The lower part contains a thin stratum of limestone, made of broken valves of a pentamerus. This is the only instance of shells broken by attrition that has come under our observation throughout the whole transition order. Above the pentamerus, the well known trilobite *Asaphus caudatus* is abundant. The group is equivalent to the "dye earth" of Shropshire, which is characterized by the trilobite above mentioned.

ORGANIC REMAINS OF THE THIRD GROUP.

Plants.

Fucoides serratus.

Radiaria.	*European localities.*
Caryocrinus loricatus, Say.	
ornatus, S.	
Testacea.	
Pentamerus elongatus, C.	
Delthyris lineata, S.	Dudley.
Leptæna depressa, S.	do
Atrypa affinis, S.	do
Crustacea.	
Platynotus boltoni.	
Asaphus caudatus,	Dudley.
limulurus, Green.	
Trimerus delphenocephalus, G.	

No trilobite of this or the preceding groups has been found in the inferior strata.

4. " Saliferous sandrock" of Eaton. Red sandstone and shales occurring in the banks of Niagara river, and admirably developed at the falls of Genesee river. The organic remains consist chiefly of fucoides Harlani, nobis (F. Brongniartii, Harlan.) Veins of fresh water shells occur in it at Medina. I obtained very perfect casts of the hinge of the Unio, shewing the cardinal and lateral teeth so distinctly as to remove all doubt of the generic relations of the shell.

ORGANIC REMAINS OF THE FOURTH GROUP.

Plants.

Fucoides Harlani, C.
Dictuolites, Beckii, C.

Polypharia.

Catenipora escharoides, G.

Testacea.

Unio primigenius, C.
Lingula cuneata, C.
Orthocera ——
Cyclostoma pervetusta, C.
Planorbis trilobatus, C.

5. The fifth group consists of olive sandstone and slate, cut through by Salmon river, in Oswego county. Intercalated strata of limestone occur in the lowest portion of the series, full of brachiopodous bivalves. This and the preceding red sandstone group correspond in geological

position with the fourth group in the slate system of Wales, described by Professor Phillips.*

ORGANIC REMAINS OF THE FIFTH GROUP.

Plants.	*European localities.*
Various species of fucoides differing from those of the red sandstone.	
Testacea.	
Conularia quadrisulcata, S.	Gloucestershire.
Cyrtolites ornatus, C.	
Pterinea carinata, G.	Coblenz.
planulata, C.	
pholadis, C.	
modiolaris, C.	
Leptæna planulata, C.	
Delthyris striatula, G. (lower strata)	Eifel.

6. Black limestone and shale of Trenton falls, embracing the "birdseye limestone" and "calciferous sandrock" of Professor Eaton, and the grauwacke and slate of the Hudson river. The group clearly represents the "black shale enclosing beds of grauwacke, flagstone and calcareous slate, which, prolonged to the southwest, join themselves to the trilobite beds of black limestone and calcareous flagstone at Llandeilo."† In Mr. Murchison's table this group is termed "Llandeilo flags."

ORGANIC REMAINS OF THE SIXTH GROUP.

Plants.	*European localities.*
Fucoides serra, Brong.	Wales.
dentalus, B.	
demissus, C.	
fibrosus, C.	
scalaris, C.	
fimbriatus, C.	
lineatus, C.	
ramulosus, C.	
Polyparia.	
Trianisites Cliffordii, Raf.	
Columnaria sulcata, G.	Europe.
Cyathophyllum ceratites, G.	Eifel.
Gorgonia ——	

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* Encyc. Metrop. article Geology, p. 568.

† Ibid.

Testacea.	*European localities.*
Pleurotomaria cirriformis, S.	Plymouth.
Bellerophon apertus, S.	Eifel.
Conularia quadrisulcata, S	Gloucestershire.
Spirula constricta, G.	
Orthostoma communis, C.	
Trocholites ammonius, C.	
Phragmolites compressus, C.	
Orthoceras duplex, W.	
striatum, S.	Christiania.
Delthyris, striatula, G.	Eifel.
microptera, G	do.
pectinoides, C.	
Leptæna deltoidea, C.	
alternata, C.	
semiovalis, C.	
Lingula ovata, C.	
Crustacea.	
Isotelus gigas, Dekay.	
cyclops, Green.	
Calymene Blumenbachii, Brong,	Dudley.
Cryplolithas tesseltatus, Green,	Llandeilo.
Ceraurus pleurexanthemus, G.	
Paradoxides Beckii, Hall.	
Asaphus micropleurus, G.	

The last named trilobite has not been found entire. The abdomen and tail closely resemble those of calymene tuberculatus.

It is a curious fact, that whilst the Calymene Blumenbachii, ceased to exist in New-York after the final deposition of the Trenton series, it escaped into remote seas, and lived in the era of the Dudley limestone. The Cryptolithus tessellatus on the contrary, seems to have existed, and to have become extinct, at the same periods in the seas which deposited the rocks of Llandeilo and Trenton falls. The plants and crustacea are peculiar to this group, and of the testacea, I have observed but two species in a superior formation; *Delthyris striatula* and a small Orthis resembling O. crumena, but having invariably four plaits or ribs on the mesial elevation. Of the polyparia, one only has been noticed above the present series; *Cyathophyllum ceratites.* All these fossils occur in the second group, in the limestone of the Helderberg mountain.

DESCRIPTIONS OF NEW FOSSILS.

First Group.

POSIDONIA.

Posidonia lirata.—Shell suborbicular, convex depressed; disk with about 18 concentric angulated carinæ, and with concentric striæ. Length, nearly one inch. *Locality*, near Norwich, Chenango county.

PTERINEA.

1. *Pterinea bisulcata.*—Shell oblong, inflated, with two oblique furrows diverging from the beak, forming an intermediate carina, which is obsolete on the inferior half of the disk; surface with concentric sulci, obsolete on the posterior side. Length 2¾ inches. *Locality*. Cazenovia, Madison county.

2. *Pterinea concentrica.*—Shell ovate oblong, compressed, with numerous profound concentric striæ; disk obliquely contracted from beak to base; posterior end dilated, margin rounded. Length, 1½ inches. *Locality*, near Norwich, Chenango county. It much resembles a Modiola in outline.

3. *Pterinea appressa.*—Shell ovate oblong, flattened, disk with distant angular concentric carinæ and striated; umbonial slope very oblique and carinated; dorsal margin rectilinear, parallel with the basal margin. Length, 3 inches. *Locality*, same as the preceding.

4. *Pterinea punctulata.*—Shell profoundly elongated; disk with an oblique furrow from beak to base; surface covered with minute elevated punctæ disposed in form of rays on the anterior side; umbonial slope carinated; dorsal margin recurved; posterior extremely truncated; posterior basal margin straight. Length, 2½ inches. *Locality*, same as the preceding.

5. *Pterinea cuneata.*—Shell oblong ovate; posterior side profoundly elongated, subcuneiform; surface with obselete concentric carinæ; disk obliquely contracted from beak to base. Length, 2 inches. *Locality*, near Oneonta, Otsego county.

6. *Pterinea triqueter.*—Shell obliquely triangular, cordate; posterior slope flat, profoundly dilated; umbonial slope marginal, acutely angulated; surface with simple lines of growth. Length, from beak to posterior extremity, 1¾ inches. *Locality*, same as the preceding.

AVICULA.

Avicula tuberculata.—Shell with distant tuberculated ribs and intermediate striæ; posterior wing very large. Length, 2 inches. *Locality*, town of Madison, Madison county.

LIMA.

L. macroptera.—Shell convex; surface with obsolete radiating striæ; one wing dilated, the other small. Length, about 3½ inches. *Locality*, Cazenovia, Madison county.

MONOTIS.

Monotis princeps.—Shell convex, depressed; ear small, emarginate; radiating striæ, numerous; rugose, profound. Length, about 3 inches. *Locality*, Cazenovia.

ORTHOCERAS.

Orthoceras constrictum.—Shell smooth, tapering gradually, with a few remote transverse furrows. *Locality*, town of Madison, Madison county.

GONIATITES.

Goniatites punctatus.—Shell compressed; surface covered with minute elevated punctæ; septa with a single rounded lobe on the disk, angulated at the periphery. Length, 1¾ inches. *Locality*, near Sherburn, Chenango county.

CYRTOCERAS.

Cyrtocerus maximum.—Shell inflated, volutions few, increasing rapidly in size; transversely ovate; septa very convex. Length, 11 inches; greatest width 5 inches; diameter 4 inches.

Second Group.

LEPTANA.

1. *Leptæna punctulifera.*—Shell with the upper valve deeply concave; radiating striæ very numerous, prominent, angulated, each with a series of very regular small elevated punctæ. Length, 2 inches. *Locality*, Helderberg mountain.

2. *Leptæna indenta.*—Shell with radiating striæ; intervening spaces waved or indented. Length, ¾ inch. *Locality*, same as the preceding.

DETTHYRES.

Delthyris bilobata.—Shell small, ventricose, profoundly bilobed; surface with radiating striæ. *Locality*, same as the preceding.

Third Group.

CRUSTACEA.

Platynotus.—Depressed, apparently not contractile.

Buckler, with oculiferous tubercles, situated on the front or middle lobe. Abdomen with about 12 articulations; mesial and lateral lobes depressed; ribs with oblique grooves.

Platynotus Boltoni.—*Syn.*—Paradoxides Boltoni, Bigsby. It is unnecessary at present to give a minute description of this species; but I will remark, that the peculiar situation of the eyes in this trilobite removes it from any genus hitherto established; in which opinion I am confirmed by that of my friend, Professor Green. There is a splendid specimen of this species in the collection of the Albany Institute, deposited by Judge Buel.

Fifth Group.

PTERINEA.

1. *Pterinea pholadis.*—Shell profoundly elongated, ventricose; dorsal and basal margins parallel; posterior side rugose, or with short undulations near the dorsal margin. Length, 1¾ inches.

2. *P. modiolaris.*—Shell ovate oblong, compressed; surface with coarse concentric lines, obsolete on the posterior side; posterior extremity obliquely truncated. Length, nearly 3 inches. *Locality*, Pulaski, Oswego county, with the preceding.

CYRTOLITES.

Shell with the general form of *Cyrtoceras*, but destitute of septa.

Cyrtolites ornatus.—Shell with transverse rounded ribs and fine striæ; periphery acutely carinated. Length, 1 inch. *Locality*, Washingtonville, Oswego county.

Sixth Group.

TROCHOLITES.

Shell in the form of an Ammonite; volutions contiguous, gradually increasing in diameter; septa plain.

Trocholites ammonius.—Shell discoid, volutions rounded; septa very distinct forming grooves. Length, 1¾ inches. *Locality*, near Newport, Herkimer county.

ORTHOSTOMA.

Shell spiral; spire plain convex; terminal volution ending in a straight tube; septa few, distant, plain.

Orhostoma communis.—Common in the upper layer of the birds-eye limestone.

PHRAGMOLITES.

Shell in the form of an Ammonite; all the volutions exposed, contiguous; septa with numerous small undulations, each lobe forming the segment of a circle.

Phragmolites compressus.—Shell discoid, periphery sharply carinated. *Locality*, near Middleville, Herkimer county.

Respectfully submitted,

T. A. CONRAD, *Palæontologist.*

His Excellency
Gov. WILLIAM L. MARCY.

REPORT

Of W. W. Mather, Geologist of the the 1st Geological District of the State of New-York.

To His Excellency Wm. L. Marcy,
Governor of the State of New-York.

Sir—

Since the first annual report, I have been engaged in making a reconnoissance of Ulster and Delaware counties, in tracing some of our rock formations of Columbia, Dutchess, Putnam and Westchester counties, to Virginia and North Carolina, and since the first of July, in making the detailed geological surveys of Queens, Kings, Richmond, Columbia and Dutchess counties.

During the next season it is my intention to make the detailed surveys of the counties of New-York, Westchester, Putnam, Rockland and Orange, which comprise most of the primitive rocks (as they are called) of my district. This intimation of my intentions is made thus early, so that persons owning property and wishing certain examinations to be made, may give notice in due season. Letters, post paid, addressed to W. W. Mather, Geologist of the 1st District, Albany, requesting him to examine the mineral resources of property in those counties, will be attended to.

A series of geological queries is appended to the report, with a view to elicit information from the people of the State, who take an interest in observing the phenomena of nature around them.

Details and facts, belonging strictly to pure scientific geology, will not be made public until the publication of the final report. The object of the annual reports is to give publicity to such facts and localities as may be of practical utility, so that benefit may be derived from a knowledge of them, during the progress of the survey.

In the first annual report of my district, the details of the economical geology of Suffolk county were discussed. The geological formation of Queens, Kings and Richmond counties are similar, and in fact, a continuation of those of Suffolk county. The economical geology of those counties will, therefore, be discussed first, and then that of Columbia and Dutchess.

II. *Economical Geology of Queens, Kings, and Richmond counties.*

PEAT.

This alluvion is the result of vegetable decomposition. It varies in its aspect; the best quality is a soft, unctuous, tremulous mud, when wet, but when dry, is so compact as to receive a slight polish. When heated, it burns with flame and a bituminous odour. Ligneous, fibrous, and compact peat are the principal varieties. The two former are of comparatively little value. The latter is extensively used in France and Ireland, and is considered a valuable fuel. It is used not only for domestic purposes, but also in burning lime, bricks, and pottery. In cold climates it is formed in moist ground and shallow ponds, wherever there is an accumulation of vegetable matter. Decayed trees form a light, soft, spongy mass, called ligneous peat; from decomposed grasses and seeds, a fibrous peat is formed, which is light and spongy several feet below the surface, but at a greater depth it may be of a good quality for fuel; small aquatic plants, and mosses, such as the sphagnum palustre, produce peat, which at a moderate depth is compact, without fibres, uniform in its texture, and of good quality. Peat, although not very abundant in Queens, Kings, and Richmond counties, is very common. Many localities were observed. Those of the most importance are near Newtown. From a bog one mile westerly from Newtown, peat of a very superior quality has been dug for more than fifty years, and it is much used by some of the inhabitants. An extensive marsh of peat, which is probably deep, and of fine quality, lies near the road from Williamstown to Jamaica, and is called the Cedar Swamp.

There may be about 30,000 cords of peat in this swamp. Small bodies of this combustible were seen in the ranges of hills in Kings and Richmond counties. A meadow of two or three acres of ligneous peat was observed about one mile north of Jamaica. The owners of quagmires or quaking meadows will do well to examine them. Before many years shall have elapsed, these bogs will become valuable, where they are now regarded as nearly worthless. The inferior qualities of peat will, under judicious treatment in compost heaps, make a valuable manure. Many of the swamps and marshes, where this combustible abounds, are overgrown with bushes and trees, but those which are free from timber are generally covered with moss and cranberry vines. The latter variety trembles when walked upon. The peat is so soft below the surface that a pole may be thrust many feet into it.

Coal and wood are now so expensive, that peat must come into general use among a large class of people, and it ought to be worth at least $1 per cord in the swamp, where wood is worth $3. Marine peat, which is abundant in the salt marshes of Long Island and the adjacent islands, is of an inferior quality, and is not worth notice as a combustible, though it may be of great value as a manure, when rotted with lime.

Another use suggests itself to my mind, which is, that it may be applied to the manufacture of carbonate of soda, by burning it. I do not know that such an application of this material has ever been made. Peat is common on Staten Island, and the ashes of this combustible have been used there successfully as a fertilizer.*

Salt Marshes.

The marine marsh alluvions of the coast of New-York are of great extent. The relative proportion of salt marsh on the coasts of Queens, Kings and Richmond counties, is much greater than on those of Suffolk county. These marshes are now forming, and have been for an unknown period of time. In some places they are washing away, in others they steadily increase in extent. I have been credibly informed that grass now grows on a marsh near Rockaway, where vessels have floated within the memory of my informant. On Coney Island, also, Mr. John Wyckoff informed me, that many places which were ponds and pools within his recollection, now produce good crops of grass. A very aged man also recollects having seen the surf roll in at the foot of the upland north of the marsh towards the east end of Coney Island. A broad marsh now intervenes between the upland and the beach. Numerous local facts of this kind, of less remarkable character, might be brought before the public; but in an economical point of view, the mere expression of the general fact, that the marshes, as an aggregate, are steadily increasing, is sufficient.

A combination of several of the causes producing salt marshes, is particularly favorable to their rapid increase; such, for instance, as the alluvion washed down by streams; the fine materials swept from the headlands and carried into the bays and re-enterings of the coast by the flood tide where they are deposited; the fine earthy matters, formed by the surf grinding the pebbles on the coast, being transported by the tidal currents into the bays and marshes and deposited there; the growth and decay of multitudes of marine animals; the accumulations of marine plants, drifted sea weeds, and other refuse of the ocean; and clouds of drifting sand; all of which concur to shoal the water more or less rapidly in situations where it is protected seaward by beaches and islands.

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* Cultivator, Nov. or Dec. 1837.

These marshes are valuable on account of the salt grass, of which they yield an abundant crop. This grass is usually cut and cured in October. Many of these marshes are so located that, with a trifling expense, the tide, surface, and spring waters of the adjacent country, might be excluded, and they thus be rendered capable of tillage, like those of Holland. The soil is very rich; in fact, it is composed mostly of organic matter, mixed with some lime and saline substances, and can be made to produce valuable crops. It is scarcely possible that another generation will pass away, before the suggested improvement will be made on some of these rich alluvions. The value of land on Long and Staten Island will not always allow these marshes to be as unproductive as they are at present.* Many of them might also be employed to advantage in the manufacture of salt from sea water, both by solar evaporation in summer, and by allowing it to freeze during winter. It is well known that it is the fresh water only which freezes, thus rendering the brine much stronger, and that it can be so concentrated until the salt separates in a crystallized state.

The disadvantage in winter would be, that only one crop of crystals could be obtained; but an area of 60 acres, divided into compartments of 10 acres each, communicating with each other, so that 6 feet of water could be let into the first, would give for a single crop from 25,000 to 30,000 bushels of salt.

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* When these marshes shall be cultivated, it is anticipated that no difficulty will be encountered in procuring good fresh water, both for men and animals. The geological formations in the vicinity of Newark are similar to those of Staten and Long Island. The following section, obtained by Mr. Disbrow, in boring for water in the Newark meadows, will shew the strata passed through; and from the bottom an abundant supply was obtained, which arose to within three feet of the surface.

Marsh mud and roots,	10	feet.
Quicksand,	12	"
Blueish grey clay,	36	"
Sand,	6	"
Ash colored clay,	20	"
Stiff variegated clay,	20	"
	104	"

[Vide Amer. Jour. Science, vol. XII. p. 139.]

Localities.

The principal marshes of Long-Island are, Nepeague marsh; one between Sagg-Ponds and Mecock bay, east part of Shinnecock bay; between Moriches and Great West Bay; between Ocombamack neck and Fire-Place; Ocombamack neck and Patchogue; Patchogue and Nicholas neck; and the very extensive one from Nicholas neck to Rockaway; and those about Jamaica bay and Coney Island.

There are also many on the north shore of Long-Island, the principal of which are at Acabonnick, Oyster-ponds, Riverhead, Wading river, Smithtown harbor, Crab meadow, Lloyd's neck, Oyster Bay harbor, between Peacock and Oak neck, Musquito cove, north part of Cow neck, Little neck bay, Flushing, Williamstown, Brooklyn, and Cowannus.

The salt marshes of Staten Island, though not numerous, are extensive. The principal are the Greatkill meadows, Freshkill marshes, and those along the west coast of the island.

The salt marshes of Suffolk county are estimated to cover an area of 55 square miles; of Queens county, 40 square miles; Kings, 12 square miles, and Richmond 9 square miles; making an aggregate of 116 square miles, or 74,246 acres, of marsh alluvion of the south coast of New-York, exclusive of the extensive marshes on the south coast of Westchester county, which would probably swell the aggregate to 125 square miles, or 80,000 acres.

As these alluvions are so extensive, the importance of rendering them most productive is sufficiently apparent.

Encroachments of the Sea.

Several examples of the encroachments of the sea on the land in Suffolk county were mentioned in my first report. Others equally interesting and instructive, and as important in their bearing upon economical and topographical geology, occur in Queens, Kings, and Richmond counties. Hog Island, as it has been called, or Middle Island, the name given by the coast surveyors, is gradually wearing away in many places by the action of the waves during storms and high tides; but the N. N. E. and N. W. parts, are exposed to the waves of Long Island Sound, and are wearing away more rapidly. The materials of which this Peninsula, as well as nearly the whole of Long Island, is composed, is a series of beds of sand, gravel, loam and clay. Boulders and erratic blocks occur in one of the beds in great numbers, and as the surf undermines the cliffs, they tumble down, and all the finer materials are swept away by the tidal currents, and the oblique action of the surf on the shore. The headlands, generally, of the north shore of Queens county, are washing away. The blocks of rock which were once imbedded in the loose soil of the island are seen on the beach, extending out far beyond low water mark.

At Oak Neck, Fox Island and Martinecock, as well as at Middle Island, the boulders extend far out at low water, and demonstrate the encroachment of the sea on the land. Middle Island and Oak Neck, are parts of a peninsula which lies between Oyster Bay and Long Island Sound. They were once islands, but have been connected with each other and with Long Island, by beaches formed of detrital matter, swept from the headlands of Middle Island and Oak Neck. Extensive salt marshes are forming under the protection of these beaches, and are materially increased by the sand drifted from them. These beaches are observed to vary in form and magnitude, being sometimes increased or diminished in particular parts by the effects of a single storm. Fox Island, so called, was once an island, but it is now connected with Oak Neck and Long Island on the east by a long beach. A long sand spit of a mile and a half in length, extends to near Peacock's, where it is cut off by an inlet, which communicates with the extensive marsh between Fox Island and Long Island. This beach and spit are derived from the materials washed from Fox Island and Oak Neck.

Peacock's Point is also washing away. Stumps and logs of wood are seen below low water mark. Martinecock Point, a mile or more west of Peacock's, must have washed away rapidly. A long point of boulders and blocks stretches far out into the Sound at ebb tide. This was once an island, which is also connected with Peacock's by a long sand beach. Another ancient island, now connected with Long Island on the S. W. by a beach, is very near Martinecock on the W. These two islands and beaches enclose a large pond, the inlet of which is through a mill sluice between them. Mr. Jacob Latting, who is an old and respectable inhabitant, and has been a resident in the vicinity more than half a century, informed me that these have been worn away many rods within his recollection. Mr. Latting pointed out to me the position of the beach between Peacock's and Fox Island, during the revolution. The beach them dammed up the outlet of a marsh, through which a small stream ran, and a trunk was put in the beach in 1778, to allow the water to drain through, in order to prevent flooding the meadows. I saw the trunk in its original position. The beach has since made out about 200 yards in front of where it was at that time. He observed that these beaches are subject to considerable variations by storms, the materials being tumbled along either eastward or westward, according to the direction of the wind.

Sands' Point, on which a light-house has been long built, was washing away so rapidly some years since, that it became necessary to protect it by building a strong sea-wall along the shore. A reef of rocks, (the remains of ancient lands,) extends out some distance from the shore. The wall has afforded a protection against the encroachment of the sea, and about an acre of land has been added to that belonging to the United States, in consequence of the alluvial action of the surf depositing the sand and shingle in the eddy on the south side of the point. Mr. Mason, the keeper of the light-house, communicated these facts, and many others of much interest. The broad and extensive sand beach south of Sands' Point, a mile or more in length, was, since his remembrance, a salt marsh covered with grass. Mr. Mason is nearly 80 years of age. The materials swept from Sands' Point and deposited on the edge of the marsh, have been drifted and washed over its surface.

At and near Kidd's Rock three quarters of a mile eastward of Sands' Point, the wasting of the cliffs from the effects of the waves is very evident. The cliffs present mural escarpments towards the Sound, but the hills slope down gradually on the other side towards the salt marsh. This elevated land was formerly an island, but alluvial causes have formed a salt marsh where the water was sheltered from the sea. The wasting of the cliffs has caused the formation of long beaches, one connecting Kidd's Point with Sands' Point, and the other connecting with the high grounds S. E. of the marsh on the W. side of Hempstead Harbor. A small inlet through the N. end of this beach allows the tide to communicate with the marsh. Boulders and blocks are seen imbedded in the strata forming the mural escarpements, and the shore below is also strewed with them. They also extend some distance from the coast, indicating that a considerable breadth of land has been washed away. The boulders protect the shore for a time, but the smaller ones and the shingle are gradually ground up by the action of the surf, and washed away, and during storms and high tides, fresh inroads are made. The beach between Kidd's Point and Sands' Point covers a part of the marsh, the ooze and marine peat of which, may be seen at the foot of the beach at ebb tide. This indicates that high land or else a beach was once farther seaward, to afford protection for the formation of that part of the marsh. Only a few acres of high land remain at Kidd's Point, and if it should continue to be washed away as heretofore, (and much expense would be necessary to prevent it) a century or two would be sufficient to effect its entire removal.

Kidd's rock, as it is called, is a remarkable erratic block which was imbedded in the loam of the tertiary formation. It has been undermined by the action of the sea, and has slid down to the shore and cracked in many large fragments. Viewing it from a little distance, one does not realize its magnitude, but by climbing over and wandering among its fragments at low water, it seems to grow upon the imagination. Its fragments probably weigh at least 2,000 tons, and several sloop loads of it have been shipped to New-York for building stone. It is hornblendic gneiss, and some of its masses abound in epidote. It is a durable stone and will stand any exposure unchanged.

Several companies of diggers for Kidd's money have expended much time and labor at this place. Mr. Mason relates many amusing anecdotes relative to their mode of operating, and the ceremonies practised, some of which are sacrilegious. The superstitions connected with these gold hunters are a rarity of this enlightened age. I presume I speak within bounds when I remark, that in examining the geology of Long Island, I have seen many hundreds of excavations on the east side of the boulders and erratic blocks, where the gold hunters have dug for this pirate's money.

The rock called Kidd's Rock, at Kidd's Point, three-quarters of a mile eastward of Sands' Point, is not the same that was known by that name a century ago. Mr. Mason informed me that Kidd's Rock was formerly the extremity of the Point, but was long ago undermined by the waves. He remembers having seen it as an isolated rock, some distance from the shore, but it has long since disappeared, and the rock on the present point is called by that name. Had the money diggers been aware of this fact, it might have spared them the labor of searching here. In some parts of Long Island almost every boulder and block has had an excavation made by its side.

Barker's and Hewlet's points have also been worn away by the action of the sea; but the Sound is here so narrow, that the destructive agency of the waves is not so great as at the localities before mentioned.

Many other localities, where the same effects are in progress, on the west and southwest parts of Long Island, might be mentioned; but they are less marked in their effects, because they are not so much exposed to the fury of the surf from broad sheets of water.

Coney Island, which is mostly alluvial, is rapidly washing away on its south side, where it is exposed to the full force of the ocean swell. A new direction given to the tidal currents by some recently formed bar, is probably the cause. Mr. John Wyckoff, who lives near the Ocean-House, remarked that the sandy part of the island was a mile broad not many years ago, though now it is not more than half that breadth. He informed me that every storm made a sensible difference, and that some years ago the sand hills south of the Ocean-House were covered with small pines and bushes, and that in a single night, during a violent storm, the trees and bushes, and much of the earth, were washed away.*

The high grounds near the two light-houses on Staten Island are wearing away by the action of the waves, and the materials are mostly deposited on the adjacent beaches, which extend for a considerable distance west of Fort Tompkins, and east and west of the southwest light-house. The high bank near Brown's point, on Staten Island, is also washing away. Here a bank of shells about two feet thick is exposed, within eight or ten inches of the natural surface of the ground. They appear to be recent shells deposited there, not by nature, but by the hands of the aborigines of the country.

Beaches, Spits, Bars, &c. of Queens, Kings, and Richmond counties.

The beaches at Middle Island, Oak Neck, Fox Island, Peacock's, Martinecock and Sands' Point, which are formed by the accumulation of the sand and shingle swept from the adjoining headlands by marine currents, and the oblique action of the surf, have already been mentioned. Other beaches, but not so extensive, occur on the north coast of Queens county.

Sand spits are unfinished beaches, and long tongues or points of land, formed of sand and shingle, by the transporting action of currents and the waves.

In Cold Spring Harbor, a sand spit extends from the west shore, obliquely, nearly across. It is formed by the northeast storms driving in a heavy swell, which washes away the high banks at the south point of land between Cold Spring Harbor and the entrance to Oyster Bay. The materials are transported by the currents and waves, and deposited to form this spit.

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* At low water, traces of the ancient salt marsh can be seen, about one mile east of Mr. Wyckoff's, on the edge of the beach. This is conclusive evidence that this part of the island is washing away, if verbal evidence from observing individuals long resident on the spot was not deemed sufficient.

A similar spit has formed nearly across Hempstead harbor, about three miles south of the mouth of the bay, and two miles north of the village of Montrose, at the head of the bay. It extends from the west shore, in an easterly direction, nearly across the harbor, leaving a deep inlet of 100 to 150 yards wide next to the eastern shore. It is owing to the same cause as the spit at Cold Spring. This spit is probably a thousand yards in length, but is not materially affected by storms. The detrital matter *now* swept coast-wise, is carried *through* the inlet and deposited in the inner harbor. Two large shoals have thus been formed, and it is said they are evidently becoming shallower every year, and at no distant time will form a considerable addition to the land. A small spit extends from the eastern shore, a short distance north of the east end of the large one. Another spit, which extends, on the west side of the bay, from the high bank on the west side of the harbor, towards Kidd's Point, is separated from this point only by an inlet of 30 or 40 yards, through which the tide flows into the marsh behind Kidd's Island. It is formed from the detrital matter both of this bank and of Kidd's Point.

A spit of some hundred yards in length extends from the north, partly across the mouth of Plandome Bay. It is derived from the detritus of some high banks in the bay, and Barker's Point, on the north.

There are beaches and spits on the south side of Staten Island, but of no great extent or importance. The beach extending southwest from Fort Hudson, and that opposite the Great Kills, are the most extensive.

The beaches and spits we have been considering are trifling in extent and importance, when compared with the Great South Beach of Long Island. This is a line of alluvial sand and shingle, extending from Nepeague, in East Hampton, to the mouth of New-York Bay, a distance of 104 miles, and having a direction of about W. S. W. It is not continuous, but is divided by inlets communicating with the bays which are situated between this and Long Island, and through these inlets the tide ebbs and flows. At Quogue and several places east of this, Long Island communicates with the beach, either by marshes or by the upland; but westward, for about 70 miles, a continuous line of bays, from half a mile to six miles broad, extends uninterruptedly, and separates the beach entirely from Long Island. This Great Beach is a line of spits and islands. One of the islands is about 25 miles long, with a breadth of a few hundred yards. They are all narrow and long, and when above the reach of the surf, they are covered by a labyrinth of hillocks of drifted sand, imitating almost all the variety of form which snow-drifts present after a storm.

Rockaway Neck is the only locality west of Southampton, where the upland of Long Island approaches near the alluvial beach. The land through this distance is increasing in area by constant depositions. The beach at Far Rockaway, and for many miles east and west is undergoing frequent local changes. The surf frequently washes away several rods in width, during a single storm, and perhaps the next storm adds more than had been removed by the preceding. The sea frequently makes inlets through the beach to the bays and marshes, and as frequently fills up others.

The inlet to Rockaway Bay, called Hog Island Inlet, is continually progressing westward by the oblique action of the surf driving the sand, gravel, and shingle in that direction. The deposit of these materials on the west end of the island beach, tends to obstruct the inlet to the bay; but the strong tidal current during the flow and ebb of the tide washes away the east end of Rockaway beach, as rapidly as the other forms. The inlet is thus kept open. Mr. Edmund Hicks, of Far Rockaway, has been long a resident here, and to him I am indebted for the fact just mentioned. He knows Hog Island inlet to have progressed more than a mile to the west within 50 years.

New Inlet is the main inlet from the Ocean to the Great South Bay. It was formed during a storm not many years ago.

Crow Inlet and Jones' Inlet are undergoing changes analogous to that of Hog Island Inlet.

Barren and Coney Islands are a part of the Great South Beach of Long Island.

Coney Island has already been referred to as washing away by the waves and marine currents. It is alluvial with the exception of a very small tract of tertiary, and is separated from Long Island by a small creek which winds through the salt marsh. Mr. Wyckoff, who has lived for many years on the island, remembers when this was a broad inlet; but it has been gradually filled up with silt, organic alluvions, and drift sand, until it is reduced to its present size.

The south part of Coney Island is a labyrinth of sand dunes, formed by the wind, which present almost every imaginable shape that such a material can assume. These hillocks are from 5 to 30 feet high, with a few straggling tufts of beach-grass, and clumps of bushes half buried in the drifted sands. They owe their origin to a tuft of grass, a bush, or a drift log, serving as a nucleus. As the grass grows the drift sand settles among its leaves and partly buries it, and the process is renewed for years, until a sand hill is formed. On the contrary, where there is nothing to bind the sand together, or shelter it from the wind, it drifts away, leaving deep hollows. Drifted snow banks afford an apt illustration of the sand dunes of the south beach of Long Island, and in a high wind we can there realize, in a small degree, the sand storms of the African and Arabian deserts.

It has been remarked that some of the islands and spits of the Great South Beach, are continually receiving accessions on the west end. Long bars form in the prolongation of the beaches, so that each successively overlaps the other, the entrance being from S. W. to N. E. They project in echellon, from the E. N. E. to W. S. W. Many of these shoals, formed at some distance from the land, are gradually driven landwards by the surf, and make new additions to it.

During the investigation of the various alluvial causes now in action on this coast, we easily trace the origin of this great sand beach of more than one hundred miles in length.*

The encroachments of the sea on the east end of Long Island, were discussed in my first annual report. Vast masses of the cliffs of loam, sand, gravel, and loose rocks, of which Long Island is composed, are undermined and washed away by every storm. The water on the ocean coast, to some distance from the shore, is almost always found to have more or less earthy matter in suspension, much of which, except during storms, is derived from the grinding up of the pebbles, gravel and sand by the action of the surf. This earthy matter is carried off during the flood tide, and in part deposited in the marshes and bays, and the remainder is transported seaward during the ebb, and deposited in still water. After a close observation, I have estimated that at least 1,000 tons of matter is thus transported daily from the coast of Long Island, and probably that quantity on an average is daily removed from the south coast, between Montauk Point and Nepeague beach. This shore of 15 miles in length, probably averages 60 feet in height, and is rapidly washing away. 1,000 tons of this earth would be equal to about one square rod of ground, with a depth of 60 feet. Allowing this estimate to be within the proper limits, more than two acres would be removed annually from this portion of the coast. It is probable that any attentive observer would not estimate the loss of land there at less than this amount. Nearly one-half the matter coming from the degradation of the land is supposed to be swept coastwise in a westerly direction.

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* In Europe there is no deposit of a similar character to compare with it in extent. It is hoped that the topographical maps of Long Island may be completed and published by the Government, in season to make use of them for illustrating, in detail, the minute geology of this interesting region. Our county maps are not sufficiently accurate for this purpose.

There are many evidences that the east end of Long Island was once much larger than at present, and it is thought probable that it may have been connected with Block Island, which lies in the direction of the prolongation of Long Island. From Culloden Point, a reef of loose blocks of rocks projects similar to those points on Hog Island, Oak Neck, &c. where they are known to result from the degradation of the land. Jones' Reef, N. W. of Montauk Point, is similar, and Shagwam Reef, a little farther west projects three miles from the shore. It is ascertained that black fish (Labrus tautogo—Mitchill) are rarely found except about a rocky bottom. It is also known that such a bottom of loose blocks of rock is found wherever the natural soil of Long Island and the adjacent islands, has been washed away by the sea. These facts, with the well known extensive fishing grounds for black fish around Montauk Point, and particularly on the south shore, and between Montauk Point and Block Island, give much probability to the idea, that a great extent of land has been washed away by the sea.

Even if these evidences were insufficient, the present rapid degradation of the coast in that vicinity, the constant transportation of matter westward upon the Great Beach, and the extent of this beach, (more than 100 miles long, with a breadth of 100 to 1,000 yards) which is the result of this action, would by most minds be deemed conclusive.

Erratic Blocks.

I employ this term, because it expresses that the materials constituting the formation have been transported from their original position, and deposited in another, and because it avoids theoretical considerations, influenced by which, some would refer them to diluvial agency, and the epoch of the deluge, while others to the time of the tertiary deposits, and others still to alluvial causes.

The masses forming the erratic block group, and terrain de transport, are composed of blocks, boulders, pebbles, gravel, sand, loam and clay, which are formed of the broken up rocks reduced to various degrees of fineness, and transported to a distance from their original situation. The rock formations in most parts of our country are more or less covered by a mantle of this deposit, of variable thickness.

The erratic blocks of Suffolk county, and the facts relative to their general distribution, were alluded to in my first report. These blocks are the only wall stones and building stones on Long Island and the contiguous islands, with the exception of a small tract of gneiss in places near Hurlgate. The boulders and erratic blocks are found on the surface, and embedded in a series of strata forming the range of hills which extend through Staten, Long, Plum, and Fisher's islands. The boulders on Long Island are rarely found south of the hills, but on the north they are observed, both embedded and on the surface, extending to the north shore. The varieties of rock forming the boulders in Suffolk county, were mentioned in the first annual report to be exactly similar, in all their characters, to rocks of granite, gneiss, mica, slate, hornblendic rocks, scienite, greenstone, serpentine rocks, verd antique, red and gray sandstones, &c. which occur in place in a northward direction from the localities where they are now found. It has also been observed, that the general direction of these boulders form beds of similar rock in place, does not coincide with the line of bearing of the strata, or the direction of the hills. In Queens and Kings counties, the same general facts are observed. Granitic and gneissoid rocks predominate on the hills and shore, from Oyster Bay to Little-Neck Bay, and thence to Brooklyn greenstone rocks are most abundant. The various rocks occurring on Long Island as erratic blocks, are much used for fences, wall stones in wells, cellars, and basements of buildings. They are nearly indestructible by atmospheric agents, and will therefore be very durable. The sea wall at Sands' Point is built of fragments of the boulders found in the immediate vicinity.

Some of the erratic blocks are of great magnitude. Hundreds of them have been seen that would weigh 50 tons each. Kidd's Rock has already been mentioned as a large erratic block, the fragments of which cover an area of 10 to 15 square rods, and weigh at least 2,000 tons. A large block was seen, half a mile to a mile S. S. E. from the churches in Plandome, called Millstone Rock, and from an observation of its cubic contents, it was estimated to weigh 1,800 tons.

Some blocks of limestone, weighing from one to five tons each, were seen on the beach of Kidd's Island, half a mile from Sands' Point, which are precisely similar in mineralogical characters to the range of limestone extending from Barnegat to Pine Plains, in Dutchess county.

Adjacent to these, were blocks of tremolite, of a yellowish grey colour, and a species of grey amphibole, nearly like the Edenite of Orange county. On the north shore of Oak Neck, masses of granite, containing yellow feldspar, were observed. I have never seen granite in place similar to this. Red sandstone, and a few boulders of greenstone, also occur here.

A boulder weighing three or four tons, of dark green serpentine, containing radiated anthrophyllite, was found half a mile S. W. of the head of Little Neck Bay. A large boulder of gray tremolite was found on the east shore of Cow Bay, in Plandome. Boulders of steatite and of talcose rock, containing anthrophyllite, were seen near the head of Little Neck Bay. Boulders of green, black, and sandy green serpentine, like those of Hoboken and York Island, are found at Brooklyn, Williamstown and Jamaica. Boulders of a peculiar rock, composed of the materials of granite, with the feldspar in a state of decomposition, are found at Flushing, Williamstown, Brooklyn, and on Staten Island. Boulders of granular white limestone, sometimes containing tremolite, occur at Hog Island, Lloyd's Neck, Oak Neck, Sands' Point, Hewlet's Point, Flushing and Williamstown. They are similar to the limestones of Westchester county. Near Fort Hamilton, serpentine, greenstone and red sandstone, with some granite and gneiss, like those of York Island, form the mass of boulders. On Staten Island, serpentine, greenstone, granite and gneiss predominate.

In the interior of Staten Island, a boulder of limestone filled with fossil shells, and similar to that of Becroft's Mountain, near Hudson, was dug from a well at a considerable depth. A boulder of silicious limestone, like one of the strata of the Helderberg, containing fossils, was dug from another well on Staten Island. These boulders were seen by Mr. Hazzard, who gave me specimens of these blocks, which he had preserved. I found a small boulder of decomposed rock, on the shore near the southwest light-house, filled with fossil remains similar to those of the middle limestone of Becroft's Mountain, Columbia county. Dr. James Pierce describes petrifactions of marine shells in rocks excavated on Staten Island, 20 feet below the surface, and 60 above the ocean.*

These examples are adduced with a view to show the directions of transport of rocks and minerals peculiar in character, and they have an economical application in affording facilities for tracing out beds of valuable minerals and rocks, by means of their transported fragments.

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* Am. Jour. Science, I. p. 145.

Sands and Clays.

Sands and loams interstratified with beds of gravel, pebbles, boulders, and clay, form the strata of Long Island, and a large part of Staten Island.

In a scientific view, these beds are extremely interesting; but in the annual reports the economical relations only will be discussed. Silicious, garnet and iron sands are the principal varieties. The first skirts the whole coast of Long Island, and the contiguous islands and beaches, as well as Staten Island, except along the edge of the salt marshes on its western shore. It is generally very white, containing particles of red and white feldspar, mixed with a few grains of black hornblende and magnetic oxide of iron. Some of it is sufficiently pure to make white glass. Large quantities of the sand from the Great South Beach are shipped to New-York and from thence into the interior, where it is employed for sawing marble, making glass, and various other purposes, which, although of little importance, causes a large consumption of the article.

Garnet and iron sands cover the beaches in many places, but they are seen more abundant after storms, when the surf separates these heavy sands from those which have a less specific gravity. In many places they may be collected in quantities after storms. Garnet sand may be used as an imperfect substitute for emery, and for blotting sand. The iron sand is extensively used for the latter purpose, and in some places it is employed as an iron ore. A forge in Connecticut is entirely supplied with this ore, which is made directly into bar iron.

Clays are not very abundant in Queens, Kings, and Richmond counties. White and blue clays, like those of West Neck, Loyd's Neck, Eaton's Neck, &c. are found on Middle Island, and the eastern shore of Hempstead Harbor, but they are so near the water level, where they were seen, that there is little probability of their being extensively useful. The white clay on the western side of Middle Island is very pure, lying in view at high water mark, and perhaps extending higher in the bank, but covered with sand which has slidden from above. Reddish loamy clay was seen in the deep excavation of the streets through the hill between Brooklyn and Gowannus. An imperfect sandy brick earth occurs on the hills about one mile north of Jamaica. At this place from 300,000 to 350,000 bricks are made per annum. Another kiln is said to be located at Musquito Cove, at which 300,000 bricks have been made during a year

Clay occurs at and near Rossville, on Staten Island. It is the dark blue astringent clay, containing a great proportion of pyrites in nodules and grains. When exposed to the air for a time, it acquires a green efflorescence, which has the appearance, at a few feet distant, of serpentine, but which is in reality sulphate of iron. The pyritous masses in the clay are often covered with beautiful brilliant druses of crystals of sulphuret of iron. Lignite also abounds in this clay.

Small slides were seen in the valley of a stream near Rossville, which led me to examine for clay. This pyritous astringent blue clay is similar in its general characters to that of Cheesequake and Matavan Point, on the Jersey shore, and it appears to have a similar geological position. This clay is extensively developed in New-Jersey, and there it overlies the marl deposits.* This stratum is, then, one of much economical interest, for if marl beds of easy access can be found, they will be of great value.

Springs, Wells, &c.

The springs of Long Island are numerous, and present some phenomena worthy of consideration. Around the heads of the bays and re-enterings of the coast along the north shore of Long Island, copious springs break out very little above tide water level. In some instances they boil up through the sand and gravel so as to form a brook at once; in others, several springs break out at the foot of the bank, and uniting their waters, form a stream. The numerous mills and manufactories on the shores of many of the re-enterings of the northern coast of Long Island, and which have no apparent streams communicating with their ponds, to renew the supply of water, attract the attention of most observers. The water of these springs is very pure, in consequence of its having been filtered through beds of nearly pure silicious sand and gravel. It is thrown out at the level of tide water, or at a higher level, where there are strata impermeable to it. Some of the most remarkable of these springs which are applied to manufacturing purposes, are about Hempstead Harbor, at the head of Little Neck Bay, at the head of Cold Spring Harbor, and the S. W. part of Oyster Bay Harbor.

In most parts of Long Island, water is not found in quantity, and is not permanent, except at about the level of the ocean, in consequence of the porous nature of the strata.

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* Vide Rodger's Geol. Rep. of New-Jersey, p. 183.

In some places there are local deposits of clay and loam interstratified, which are basin-shaped, and contain the water. These are more abundant in the hilly regions than in the plains. Springs are as abundant and copious on the south side of the island as on the north, but they break out at some distance from the shore, in consequence of the land declining almost insensibly from the hills. The great plain of Long Island extends from the base of the hills south to the ocean, descending but a few feet to a mile. On Hempstead plains the wells are dug from 60 to 120 feet deep, through beds of gravel and sand, before water is reached, which is a little above the level of the ocean. The wells gradually decrease in depth thence to the shore. On most of the farms in the interior, artificial means are resorted to, to procure a supply of water for cattle and other farm stock. A basin-shaped excavation is made in the soil, and puddled with clay, and into this the surface waters are conducted during rains. They are called watering-holes, and are a striking feature of the farming economy of the island.

Fossil shells and lignite are not unfrequently found in digging wells in the chain of hills which extends through the island.* Such facts should be preserved, as they may lead not only to important scientific truths, but to practical results applicable to agriculture. It is well known that most of the valuable marls contain fossil shells and charred wood or lignite. The observation of such facts may lead to the development of rich marl beds, and these might be of inestimable value to the agricultural interests. Clay beds, similar in character, (and contained minerals, viz, lignite and pyrites) to that which overlies the green marls of New-Jersey, have been observed on West Neck in Suffolk county, and at Rossville in Richmond county. It is not considered improbable, that similar marls may be found connected with the same series of strata, as in New-Jersey.

Gneiss.

No rock was seen in place on Long Island, except at Hurlgate, Hallett's Cove, and a few localities along the shore within a mile or two of these places. The rocks are gneiss, hornblendic gneiss, and hornblende slate. The strata are nearly vertical, and range N. 20° E. and S. 20° W. The hornblendic gneiss and gneiss are quarried at Hallett's Cove, and are used for basement walls. It is easily dressed with the hammer, and is durable, and unchanged by atmospheric causes.

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* Dr. Pierce observed lignite on the west part of Staten Island in 1818, vide Am. Jour. Science 1, p. 146, and Dr. Beck describes it as occurring at Rossville: vide 1st An. Report of the Geol. Survey, N. Y. p. 59.

Granite.

This rock occurs in place on Staten Island, on the shore opposite Nautilus Hall, at the Quarantine. It is coarse grained, composed of white and smoky quartz, red and gray feldspar, and mica. It is seen only over a space of a few square rods, and is covered by the deposits belonging to the erratic block group. It is not of a suitable texture for a building material, and cannot be applied to any useful purpose, except as a rough wall stone.

Serpentine.

This rock forms the main ridge of hills on Staten Island, and extends from New Brighton to a little west of Richmond, a distance of eight miles. It ranges N. 20° E. and S. 20° W. and the prolongation of the line of direction strikes the Serpentine hills of Hoboken. The serpentine rock assumes a great variety of aspects, from black to nearly white, and from compact to earthy. Some of the talcy varieties are called soapstone by the people. Talc, carbonate of magnesia, and hydrate of magnesia, abound in it, and the rock might be used with profit in making magnesian salts. Asbestus and amianthus are not rare in it. This rock sometimes assumes an aspect almost like trap, but its specific gravity is much less.

Amianthus and asbestus are constant associates of our serpentine rocks, and on Staten Island it is possible that it may be obtained in quantities for useful purposes.

Dr. James Pierce described the amianthus of Staten Island in 1818.* He states that "it breaks up like flax, and may be spun and woven without the aid of moisture; and in respect to tenacity, flexibility, and length of fibre, it may be considered the best found in this country, and perhaps equal to any hitherto discovered." Prof. Silliman remarks upon the above, "the specimen of amianthus referred to in Mr. Pierce's communication, is uncommonly beautiful. The fibres measure 12 and 15 inches in length, and are as soft and flexible as fine human hair."† The value of this material is well known. It has been principally employed in making incombustible cloth for firemen's dresses. It would be more *extensively* useful in making indestructible paper for public records. The amianthus of Staten Island is believed to have been used only as mineralogical specimens.

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[*] Am. Jour. of Science, I. p. 54.

[†] Idem, p. 55.

Trap Rock Greeenstone.

A range of this rock was observed west of the Serpentine ridge. It was traced to a breadth of 200 to 300 yards, and it is probably much broader. It forms a gentle swell of land parallel to the Serpentine hills. A quarry is opened in it, about three miles from Tompkinsville. The stone is used for basement walls, and is very durable.

Iron Ore.

Dr. L. C. Beck, in his first Annual Report, described the hematite beds of Staten Island.* During the geological investigations of the island the past season, I have observed numerous slight indications of the same ore along the east base of the Serpentine hills. The ore beds, where I have seen them, are directly contiguous to the serpentine rock, which contains an abundance of carbonate and hydrate of magnesia, and which seems to have performed the same office in the deposition of the ore, as the limestone beds of Columbia and Dutchess counties.

Agricultural character of the Soils of Queens, Kings and Richmond counties.

The soils of these counties are very variable, but at least four-fifths of the surface will be characterized by the terms sandy loam and loamy sand. There are many tracts of land where the soil is a heavy loam, and even a stiff clay, and others of a pure sand, which drifts and is piled by the action of the wind. The variation of the soil is due to the different strata which form the country. Beds of sand and gravel are interstratified with those of loam and clay, and where irregularities occur in the contour of the ground, arising from denudation, a field of a few acres may exhibit almost every variety of soil, from a pure sand to a stiff clay. The art of the farmer is here put in requisition, to modify the natural texture of the soils, and fit them to receive nutritive and stimulant manures with the greatest advantage. The heavy soils are dressed with sand, and the light soils with loam or clay, with a view to transform the whole into a loam of such texture as to make a pulverulent soil, and yet have it sufficiently argillaceous to retain a suitable quantity of water. The cultivated soils within twenty miles of New-York, are so much modified by art, that their natural qualities could scarcely be determined without geological investigation. Many of the farmers expend from $50 to $70 per acre for street manure, once in two or three years, and they are well repaid for their enlightened views and liberal expenditures. The soil is naturally very poor on the plains, but those parts which are well cultivated have become very productive. Street manure, yard manure, composts, mixed with lime, rotted seaweed, on which hogs and cattle are yarded, ashes, barilla, bone manure, and fish, are those in common use. Street manure probably exceeds all the others in quantity, and the bays and inlets on the coast, together with the Long Island rail-road, offer great facilities for its transport into the interior of the island. The marsh mud, and "muck" of the meadow, and the estuary mud, would make a valuable manure on the light soils. Lime answers well on the light soils of Long Island and New-Jersey; and as it can be purchased at so low a rate at Barnegat, (viz. 6¼ cents per bushel) the farmers will find their advantage in using it on their lands. It should be put in heaps on the land, and suffered to lie some months, to air slake thoroughly, and then spread with other manure. Experience must determine the quantity best adapted to each particular soil. It is now extensively used in New-Jersey, on soils similar to those of Long Island.[*]

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* Dr. Pierce described the iron ores of Staten Island in 1818. Vide. Am Jour. Science, I. p. 145.

The astringent pyritous clay of Rossville, in Richmond county, and of West Neck, in Suffolk county, might be employed with advantage on light soils, if used in moderate quantities and mixed with lime enough to decompose the sulphate of iron, formed by the decomposition of the pyrites.

The clay at Rossville is more pyritous than that of West Neck, and would require much more time. The sulphate of iron, formed by exposing these clays to the weather, would tend to destroy vegetation. Lime is useful when mixed with it, not only to prevent its noxious effects, but the acid of the sulphate of iron, by combining with the lime, forms the sulphate of lime, or gypsum, which is so extensively used as a stimulant manure, while the clay would render the soil more mellow and loamy. Two sloop loads of the Jersey green marl have been taken to Staten Island the past season, and spread upon the sandy soil near Brown's Point. If it has been judiciously applied, benefit will undoubtedly be derived from it; but this marl, if used in large quantities, destroys vegetation. It has been used on Long Island without success, but this is confidently believed to have been caused by an injudicious application of it. I have seen land in the marl district of New-Jersey, where the fields on one side of the road were almost drifting sands with a few tufts of tall grass, while the opposite one of similar soil, which had been properly marled, was covered with a heavy crop.

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[*] The use of lime is extending very rapidly in New-Jersey and Pennsylvania, and has almost replaced the use of plaster in some of the counties. "Individuals in the vicinity of Allentown employ from 600 to 3,000 bushels of lime per year, according to the dimensions of their estates. It is carted from 20 to 30 miles, in some instances." "The quantity per acre varies, from 30 to 100 bushels, according to the strength of the soil—the largest quantity being used where the land is richest in vegetable and animal matter. The dressing is administered in from five to twelve years. Where the soil is thin, it is necessary to plough in the lime the deeper. It is always added in the slaked state, and generally in the fall of the year. After liming, a crop of buckwheat, oats or corn, is taken off, previous to one of wheat."[†] In Europe, the lime is always allowed to air slake before it is spread. Where lands are highly limed, (and sometimes 200 bushels are used to the acre in England) it is done only once in a term of twenty-one yeard. In some parts of France, a dressing of only 12 bushels is employed, and this is repeated every third year. Mr. Pulvis, who has done much in investigating the subject of calcareous manures, thinks this the least expensive and best; and as lime is so cheap on the Hudson, it must be an economical manure. "The advantage of the use of lime may be stated in a few words: it is an essential part of the seed of wheat, and that valuable grain will not grow in any soil which does not contain it."[‡]

It may be well to remark in this place, that limestones containing magnesia will not make a lime suitable for manure, however valuable it may be for cement. Farmers should be careful on this point, else they may fail in the use of lime, and infer that it is not adapted to their soil.

[†] Shepard's Min. Report of Con. p. 115. [‡] Ibid, p. 116.

Over a large portion of Long Island fish are principally depended on for manure. The fish which is used is the Clupea menhaden, of Mitchill, called also the Bony-fish, Hard-heads, and Marsbankers.* They frequent our coasts in vast shoals, in July and August, and great numbers of them are taken and carted into the interior to manure the land. They weigh from one to two pounds each, and are either spread at the rate of two or three per square yard on the ground, or are made into heaps with sea weeds or other vegetable substances. It is estimated that 100,000,000 of these fish are used on Long Island per annum. The sandy land of Suffolk county could scarcely be cultivated with profit, without the aid of these fish.†

III. *Economical Geology of Columbia and Dutchess counties, N. Y.*

INTRODUCTION.

During the past season the counties of Columbia and Dutchess have been examined in detail. Prof. Briggs, Prof. Cassels, and Mr. F. Merrick, the Principal of the Amenia Seminary, have been with me as acting assistants on the geological survey of these counties. I may here be allowed to express my obligations to these gentlemen for the carefulness, and it is believed, the accuracy of their observations.

My thanks are also due to Messrs. Reed, Rowley and Lawrence, of Hudson; Drs. Beekman and Pruyn, of Kinderhook; Dr. Stanton, of Amenia; Judge Bockee, of North East; Walter Reynolds, Esq. and Dr. Davis of Pine Plains; Mr. Van Ness, of Ancram Furnace; Rev. Mr. Woodbury, of Austerlitz; Jesse Van Ness, Esq. of Malden; Messrs. Foster, White and Wager, of Hillsdale; Mr. Bowman, of Lafayette Corners; Mr. James, of Poughkeepsie; and various other gentlemen, for their attention and hospitality, and for their zeal in aiding to carry into effect the enlightened views of the Legislature, in developing the natural resources of the State.

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* Transactions of the Literary & Philosophical Society of New-York, p. 453.

† I may here be allowed to express my obligations to Mr. W. R. Gucst, who was my acting assistant on the geological examination of Staten Island.

The rocks of Columbia and Dutchess counties, with a few local exceptions, dip to the E. S. E. and east, at angles 30° to 85°. The usual dip is from 30° to 60°. The line of bearing is generally nearly north and south, and bearing more or less to the east of north, and west of south. There are many local variations, where the line of bearing for short distances is N. W. and S. E. and even east and west, but they are always accompanied by contortions of the strata. Faults are not uncommon, and are well defined. Veins are seen almost every where. In many instances the rocks are filled with a net work of them, permeating the rocks and swelling into ganglions and nests. Fissures traverse the rocks in two general directions, viz, nearly north and south, and east and west.

A net-work of geological sections has been completed over Dutchess and Columbia counties during the past season. As it is impossible to illustrate the geological features of a country to the eye, without topographical maps, I have constructed maps of those two counties, as accurately as a coup d'œil, without measurements, would permit. The contour of the ground, the shape of mountains, hills, valleys, and their relative heights, are approximately delineated.

Alluvial Deposits.

FLUVIATILE ALLUVIONS.

The alluvions of the Hudson river have been accumulating in an increasing ratio for many years, and they must necessarily continue to do so in proportion to the increased cultivation of the soil. The rains and surface waters remove only small quantities of the soil where the surface is covered with its native forests, or with grass sward. The labors of man, in tilling the soil, in making roads, canals, and various other improvements of civilized life, expose the naked earth to the action of the surface waters, so that every shower transports more earthy matter from a higher to a lower level, than if the surface had been left in its natural state. Great quantities of the finer materials are transported in suspension into the small streams, and eventually make their way into the larger, and are carried on, until eddy currents or tranquil waters allow their deposition. The soils along the Hudson, and its tributaries, are more or less clayey, and large quantities of the muddy alluvions are brought into it and deposited. Almost every creek entering the Hudson has its delta. The alluvions of the Hudson, belonging to Columbia and Dutchess counties only, will be discussed in this report. They are numerous and highly important, both in a scientific and economical point of view. They are sensibly increasing in height and area in many localities, and will, at some future time, make valuable and productive lands. Many of them are now employed for hay and pasturage, and others are rapidly becoming adapted for such uses.

The materials of the Hudson river alluvions in Columbia and Dutchess counties, are almost entirely composed of ooze and fine silt, mixed with the remains of organic matter. These alluvions are formed whereever eddies occur, caused by a change of the general direction of the current, by islands, bars, shoals, or even small obstacles, like sunken logs, trees and rocks. The current sweeping by these obstacles circles around in an eddy, and the materials in suspension settle to the bottom. Small obstacles, as logs or rocks, are known to have thus served as the nuclei of islands. Such deposits, when covered by a depth of a few feet of water, support a great growth of aquatic plants, which entangle much of the sedimentary matter of the water, and by their own decay serve to increase the accumulating deposit. The shoal, on reaching the surface, supports a heavier growth of vegetable matter, which serves to increase the deposit in a sensible degree. One who has not examined the dense mass of vegetation on some of these alluvions, can scarcely appreciate the effects of this cause.

Local Details.

There are two islands of alluvial ooze opposite the upper part of Stuyvesant's. The larger one is nearly three miles long. An alluvial flat a mile and a half long, and on which a light-house is erected, extends from Kinderhook New-Steamboat Landing to above the lower end of the large island just mentioned. It may be considered the delta of the creek, at the mouth of which it is located.

A marsh of fluviatile alluvion extends from Great Nutten, or Neuten, Hook to Stockport Landing. Great and Little Nutten Hooks were once islands, which are now connected with the main land by the marsh. This marsh may be considered as the delta of the small creek which has its mouth between Great and Little Nutten Hooks, and which has, also, received large accessions from the detrital matter brought into the Hudson by Kinderkook creek and swept up by the tide. The mouth of Kinderhook creek is so located, that a delta of any magnitude cannot be formed there. The tidal currents sweep past it, and always press upon the shore of the Hudson both above and below.

A small marsh, and two or three small bars, are formed at and in the mouth of this creek, but most of its alluvion is swept down, or up the river, and deposited in situations more or less remote.

Opposite Hudson there is an island of alluvial ooze of a mile or more in length; a canal has been cut across it, through which the ferry boats pass from Hudson to Athens.

A large marsh of ooze between Hudson and Merino mountain is the proper delta of the creek which empties into the small bay below Hudson. From the north end of Merino mountain to the lower end of Rogers' island, is an extensive marsh of several hundred acres of alluvial ooze. It is used for pasturage. There are boulders of rock on it, left by the ice, by which they were transported. A part of this marsh is covered by such trees as grow in our swamps.

Between Rodgers' island and Catskill is an island of alluvial ooze, covered with tall grass, or a plant which is believed to be the wild rice of our northern lakes. It grows on some of the ooze islands and mud banks eight to ten feet high. From Oak-Hill ferry an alluvial ooze bank, or flat, but which rarely shows itself above water, extends eight or nine miles down the river.

At the mouth of Livingston creek, which is also called Ancram creek, and Roeleff Jansen's creek, the alluvian is coarser (fine sand and silt) and covered with reeds and aquatic plants. This delta is the largest on this part of the Hudson. Opposite the lower part of Germantown, this deposit of alluvial forms long spits, almost islands, connected with the land at one end by very shoal water, while elsewhere they are separated by pockets of very deep water. The plant, believed to be the wild rice, grows very tall on these ooze spits.

Between Upper Red Hook Landing and the mouth of the Saw Kill, an extensive alluvial deposit is forming, whicih may be considered as the united deltas of the Saw Kill and the creek which empties into the Hudson S. E. of Upper Red Hook Landing. The bay in which this disposition is taking place, is filling up by the deposits of the streams which flow into it, the wash of the adjacent clay hills on the east and north, and by organic depositions, which form a large proportion of the bulk of the accumulating matter. The aquatic plants grow very thick and luxuriantly, and by their annual decay form a large amount of carbonaceous matter, mixed with the wash of the adjacent country. Two islands cut off the river from most of the west boundary of this bay, and a marsh connects the largest island, or peninsula, with the main land, so that the water stagnates. These flats, of which there are some hundred acres, will eventually be valuable land, but several generations may pass away before that time, unless they be diked out. The islands are on a line with the rocky shore above Upper Red Hook Landing, and are the outcropping edges of the same strata.

An island of alluvial ooze is forming about two and a half miles below Rhinebeck Landing, and extensive flats under water are also in process of formation. Between Emmet's and Thompson's Landings, clay hills bound the bay on the east, in which these depositions are taking place. Three small creeks also empty into it, and by their deposits assist in the accumulation.

At the mouth of Caspar creek a small delta is forming.

At the mouth of Wappinger's creek a small alluvial deposition commences, which extends, with little interruption, until it joins that of Fishkill Creek, and continues thence to the Highlands. There are few places where it shows itself above water, even at ebb tide, but it is an alluvial bank from 50 to 600 yards broad, and nearly 10 miles in length.

There are many small alluvial marshes and flats, which are too small to notice, and they can be of comparatively little value, even prospectively, except for manure. The river ooze is every where well adapted for fertilizing the soil.

The main object in introducing these alluvions into the annual report is their prospective value as land, capable of tillage, by diking them out, where the value of land and the small expense of diking will justify the change. Some of these alluvions, if reclaimed and tilled, would benefit the health of the adjacent country. Where the water stagnates on them, bilious, intermittent and remittent fevers are produced.

Lacustrine and Marsh Alluvions.

These are formed by the combined effects of the growth and decay of organic matter, and the deposits of the waters from the adjacent country flowing through them. The nature of the material forming these alluvions varies much, according to local causes. If the water flowing into lakes or marshes, with a gentle current, be loaded with earthy matter, the ooze (or muck, as it is frequently called by our farmers) will probably predominate. When the soils contain much lime, or if calcareous springs occur in the vicinity, fresh water molusca will probably exist in quantities and cause the deposition of shell marl; if neither of these causes should predominate, vegetable matter will accumulate so as as to form peat.

The ooze, or muck, of our swamps and "pond-holes," is a black mud, composed of a mixture of earthy matter, with decayed remains of plants, of animals and their excretions. It is highly valuable as a manure, and is extensively used for this purpose, yet our farmers, as a body, do not seem to appreciate its value.

Fresh water Shell Marl.

Fresh water shell marl is very abundant in Columbia and Dutchess counties. It is formed by moluscous animals secreting lime from the waters of the lakes and ponds in which they live, to form their shells; and as generation succeeds generation, the dead shells accumulate, and form thick and extensive beds of white shell marl. When the pond or lake has shoaled to within a few feet of the usual water level, plants grow and decay, and by accumulation form peat, which, in marshes that were once ponds, covers the marl. For a foot or two from the surface of the marl, the peat is filled with small fresh water shells, similar to those which have crumbled down to form the proper marl. The pure marl is a white crumbly mass when dry, but unctuous and plastic when wet, and contains a few small, white, fresh water shells. If vinegar, or any acid, be poured on it, it effervesces, or boils up strongly. Shell marl was seen in process of formation in Peat Marl pond, about four miles north of Kinderhook, and a little east of the post road. Standing on the adjacent terrace which surrounds the lake, white shoals were seen, which, on examination, proved to be beds of white shell marl, and which had accumulated by the successive growth and decay of myriads of fresh water shells. The lake is gradually shoaling, from this cause and the deposition of peat. This lake was once far more extensive than it is at present. These causes have continued to act, until the alluvions have reached the surface, and formed a marsh. Large quantities of marl can be obtained here by draining the lake. This marl ought to be worth at least one dollar a load for use as a manure. The data for estimating the quantity of this material are necessarily imperfect, but it is probable that there are at least 100,000 cart loads of marl in this lake.

Uniones and Anadontas, (called by the people clams) and small univalves of Lymnia, Physa heterostropha, Planorbis trivolvis, and P. Campanulatus, occur here, and aid in the formation of the marl beds. Many bushels of Uniones and Anadontas were seen in piles on a small island in this lake, where they had been carried by muskrats, to devour the animals contained in them.

Numerous localities of shell marl were observed, of which the following are the most important.

Crysler's Pond, in Copake, containing probably	20,000	loads.
Rhoda Pond, do do	30,000	"
Woodward's do do do	28,000	"
Buttermilk Pond, in Pine Plains, do	70,000	"
Marsh in Pine Plains and Stanford, between Stessing Pond and Attlebury, 500 acres in extent, and an average depth of three feet, ...	1,500,000	"
Rev. Mr. Gates, of Lower Red-Hook, informed me of a locality of marl in the south part of Red-Hook, which probably contains	5,000	"
Otis C. Bowman also informed me of a locality on Rowland Story's farm, in Milan, a quarter of a mile east of Lafayette Corners, containing probably	5,000	"
Thompson's Pond, in Stanford, do	150,000	"
Upton's do do do	100,000	"
A marsh in Rhinebeck, do	5,000	"
Chalk Pond and Round Pond, in Amenia, ...	500,000	"
Deacon Sanford's meadow, two miles east of Amenia,	2,000	"
Marshes in Clinton, ...	30,000	"
Mr. R. Suckley, of Rhinebeck, informed me of a locality of shell marl on his estate. He is about applying it to his land as a manure. Its contents may probably be	10,000	"
Another locality, on the farm of Major Pultz, in Rhinebeck, is said to be extensive, probably contains	20,000	"
Long Pond, 1½ mile east of Upper Red-Hook, contains shell marl. Mr. Merrick reports that the bed is quite extensive, and it may probably contain	150,000	"

Marl is supposed to exist in abundance in the ponds and marshes in Clinton, judging from what we could learn from the people. We had no means of examining, as there were no boats on the ponds.

Rider's Pond was also supposed to contain it, though for the same reason it was not examined.

Mr. Prescot, of Hillsdale, informed me of two beds of marl in that town. One is on the lands of Mr. Mitchell and Judge Loop. This marl has been used on corn, instead of plaster of Paris, by Mr. John Chapman, and found to answer the purpose equally well. The other locality is a pond on Mrs. E. Burton's farm, near the Columbia turnpike. These marls are filled with fresh water shells. The first mentioned of these two deposits is covered by peat about two feet in depth.

The value of fresh water shell marl is well known to our intelligent farmers; but few know it when they see it, and still fewer know in what situations to seek it. For these reasons, I have particularized its characters, its situations, and some of its localities. It performs the same office on the land as air slaked lime, and is as valuable a manure, while it has not its causticity to injure vegetation. One object in burning lime for land is, to reduce it to the state of powder by slaking. The shell marl is already in a pulverulent state, and only requires to be dug from the swamps and ponds and spread on the land.

It is supposed that the above localities do not embrace one half of the quantity of this shell marl in Columbia and Dutchess counties, and it is probable that it may be found in every township. The extent of country which it was necessary for us to examine during the past season, in order to accomplish the geological survey in the time contemplated by the Legislature, rendered it impossible to visit, much less to examine, more than a small part of the localities where the marl, peat, marble, &c. &c. might be expected to occur.

The shell marl may be used to replace gypsum, or at least, a part of it, of which there is a great consumption. Gypsum has been invaluable to the lands of these counties, and it is probable that the shell marl deposits will be of as great a value to the farming interests. It is estimated that the quantity of gypsum consumed annually in Columbia and Dutchess counties, amounts to from 15,000 to 30,000 tons. This is imported from Nova Scotia, and delivered at the wharves on the Hudson river at about $5 per ton. Allowing the consumption at 20,000 tons, the sum expended annually, exclusive of that for interior transportation, and the grinding, amounts to $100,000.

Notwithstanding this heavy tax upon our farmers for the importation of a mineral manure, they cheerfully pay it, because they are amply remunerated by the increased productiveness of their farms. The use of marl may prevent a large portion of this outlay, and it is sincerely hoped that our intelligent farmers will make the experiment of the marl, which is so abundant, and which has been accumulating during successive ages of time, by the growth and decay of myriads of animated beings, with a view to the final benefit of man.

The term marl, in its strict mineralogical sense, means an argillaceous carbonate of lime, but by general usage, marl is an earthy mineral substance, which by being spread upon the soil, renders it more fertile. The marl which we have been describing, is a fresh water shell marl. The marls of New-Jersey, and the States south of it, are various in composition. Some are calcareous, and others are composed of green sandy grains, whose chemical composition is a potash silicate of iron. The marls of these States are marine depositions, and contain an abundance of the remains of marine animals. The fresh water shell-marl of New-York will not yield to any other in its fertilizing effects, unless to the green marls of New-Jersey and Maryland. If it be judiciously employed, it will return millions to the pockets of our farmers. The argillaceous marls will be discussed in another place.

At most of the localities above mentioned, estimates have been made of the number of cart loads, allowing one-third of a cord in bulk to make a load. The aggregate of the estimates is 2,725,000 loads of marl, which ought, and will doubtless, be worth $1 per load to the owners, and it is presumed that not more than one-half the localities of this useful and valuable fertilizer were observed.

Peat.

The characters, mode of formation, and the uses of this lacustrine and marsh alluvion, have been already discussed in the second section of this report. It now remains to mention the most important localities, observed in Columbia and Dutchess counties.

Local Details.

A large portion of what was once a part of Peat Marl pond, four miles north of Kinderhook, is filled with peat, and has become a marsh Other parts of this pond are filling with the same combustible, and with shell marl. It is estimated that 60 or 70 acres of this pond and marsh are filled with peat. It has probably a mean depth of at least six feet, and as each yard in depth yields about 1,000 cords per acre, when first dug, or 500 cords per acre, if we allow one half for shrinkage by drying. This marsh and pond ought to yield 60,000 cords of good peat.

A small bog of about six acres is on the farm of Cornelius P. Van Allen, three miles north of Kinderhook. The peat is of fine quality, at the depth of two feet from the surface. It has a mean depth of about nine feet, and ought to yield 9,000 cords of peat.

Another, similar to the above, in the north part of Stuyvesant, contains about 9,000 cords.

Several localities of peat in small bodies, were observed, which in the aggregate may contain 5,000 or 6,000 cords.

Round Pond in the north part of Kinderhook contains 2,000 to 3,000 cords.

The marshes and shallows of Kinderhook lake probably contain 20,000 to 30,000 cords.

A small bog between this lake and North Chatham contains perhaps two or three acres, 2,500 to 3,000 cords.

In the marsh west of the post road, one mile north from Kinderhook, peat is said to occur in quantity, probably 10,000 cords.

The marsh belonging to Mr. Lucas Hoes, 1 mile S. W. of Kinderhook, near the post road on the east side, contains about 30 acres, with a mean depth of six feet, and ought to yield about 30,000 cords.

Several other localities are said to occur in the valley of Kinderhook creek, between Kinderhook village and Stuyvesant town line, containing probably 10,000 cords.

A peat bog is also said to occur two miles N. E. of Valatie. It was seen but not examined, and probably contains 5,000 cords.

Peat bogs occur in many places in New-Lebanon, among which may be mentioned those on Mr. Gillett's and the adjoining farm, and on E. Tilden's.

Another, south of Mr. Carpenter's, of 15 acres, and three to twelve feet deep, contains about 20,000 cords.

Another, south of Fitch and Kirby's store, owned by Mr. Waite, of about 30 acres, contains probably 50,000 cords.

Peat occurs near the west side of Canaan mountain, around Adgate's pond. It has been estimated that this bog is sufficient to supply the town with fuel for a thousand years,* but this is obviously an over estimate. The aggregate amount of peat in this township is probably 400,000 cords.

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* Barnes, Sil. Jour, 5. p. 8.

Mr. Waite has used the peat of his bog as a manure on his land successfully.

Mr. Otis C. Bowman, of Lafayette Corners, informed me that peat occurs on Rowland Story's farm, a quarter of a mile east of that village, in Milan. The marsh probably contains 1,000 cords.

A bog of peat, five or six acres, with a depth of five or six feet, occurs one and a half miles east of Upper Red Hook, and probably contains 5,000 cords.

A peat bog between Stormville and Hopewell, which was not minutely examined, is supposed to contain 6,000 cords.

Several bogs between Hopewell and Fishkill appeared to be peat bogs. They were not examined. They contain probably an aggregate surface of 40 acres and 40,000 cords.

A peat bog of 5 or six acres is located about a mile and half from Stormville, on the road to Beekman, and contains probably 5,000 cords.

An extensive peat bog extends north from Long pond down the valley of its outlet, and probably contains 300,000 cords.

Mr. Davenport, who accompanied me to several localities, which he had discovered near Hudson, informed me of a bog S. W. of Becraft's mountain, and which probably contains 5,000 cords.

Mr. Staats, of Hudson, informed me of a large body of peat on Tobias Legget's farm, in Ghent, which may contain 10,000 cords.

Peat probably exists in the marsh east of Great Nutten Hook.

Jesse Van Ness, Esq. of Malden, informed me of a bog, which contains peat and marl, a mile or two west of Malden, and it may contain 40,000 cords.

On Mr. Samuel Croker's farm, in Kinderhook, is a meadow of 20 acres or more. The peat is shallow (two to four feet) and of inferior quality. Mr. C. has hrought it into cultlvation by ditching and draining it. Good grass is now raised on a soil that only a few years since was considered worthless.

Two or three small peat bogs were seen in Ghent, in passing through the south part of the town. They may contain 10 to 15 acres, and perhaps 10,000 cords.

A small marsh of ligneous peat was seen about one and a half miles north of Hillsdale.

There is an extensive peat bog on Lawrence Smith's and the adjoining farms in Amenia. Prof. Cassels reports it to have an area of about 150 acres, and contains probably 150,000 cords.

He also reports, that there is a peat bog four miles N. E. of Dover, on the east side of the creek, another one mile south of the above, another one mile south of the last mentioned, one also two miles south of Dover, and one eight miles south of Dover. These contain an aggregate of probably 75,000 cords.

Extensive peat bogs were seen east of Elbow mountain, which lies east and N. E. of Dover. They are in the valley through which the road passes from Kline Corners to the Columbia Furnace, in Kent. The northern one is about three-quarters of a mile long and 200 to 300 yards wide, with an unknown depth. Its depth was measured in several places, and it was generally five feet deep within five rods of its edge. It was once a lake, now filled with peat. Its mean depth may probably be placed at nine feet, its area at 60 acres, and its contents at 90,000 cords.

The other bog south of this probably contains 40 acres, with a depth of six feet, and its contents may be estimated at 40,000 cords.

Peat in small quantities, and of an inferior quality, occurs on Dr. Stanton's farm, in Ameniaville, and at the small marl locality on Deac. Sanford's farm, two miles northeast of Ameniaville.

Peat is found abundantly in the vicinity of Pine Plains, and some of it is of very good quality. A small bog is observed one mile south of Pine Plains. Cranberry marsh and Cedar swamp, near Stessing pond, are filled with peat. It is rapidly forming in some parts of Stessing pond. These may be estimated to contain 25,000 cords.

Peat is forming on Woodward's farm, in Copake. In Taghkanic, about a mile and a half or two miles west of Crysler's pond, a peat bog was seen of 30 or 40 acres, the contents of which may be estimated at 60,000 cords.

The drowned lands in Ancram were not examined, but from description peat probably abounds there. This marsh has an area of several hundred acres.

The marsh in the valley of Stessing pond contains a great body of peat; probably 500 acres are underlaid by it, two yards deep, and its contents may be estimated at 500,000 cords.

On Mr. Hoag's farm, in Stanford, both the peat and marl of this extensive marsh were examined. Prof. Cassels reports, that an extensive bed of peat occurs three miles east of Poughkeepsie. It is on the farm of Peter Van Voorhis, and contains about 25 acres. It is deep, and may be estimated at 30,000 cords.

A small bog occurs near the red school-house, about two miles from Union Corners, in Dutchess county. Prof. C. thinks the bog is deep, but it contains only about two acres, and may be estimated at 3,000 cords.

In Clinton, four miles east of Union Corners, is a peat bog of about 65 acres. It is on the land of Messrs. Underwood and Denison, and contains about 60,000 cords.

A large deposit of peat was observed by Prof. C. two miles south of Union Corners, on the land of Elias Tompkins. It was estimated by him at ninety acres, and may contain 90,000 cords.

Mr. Merrick observed a small peat bog, about two miles north of Hurd's Corner, in Pawling, containing probably 5,000 cords.

Another one, of nearly 60 acres, in the southeast part of Stanford, with a depth of about six feet, may be estimated to contain 60,000 cords.

Shaw pond and Mud pond, between Stanford and Washington, and Round pond, in Washington, are filling up with peaty matter.

The aggregate of the above estimates gives 2,226,000 cords of peat in these counties; and this quantity, together with that of the localities observed on which no estimates were made, would give an aggregate of probably 3,000,000 cords of peat, which ought to be worth one dollar per cord in the swamp.

This combustible has been but little used or valued by the people of New-York; but as wood and coal are so dear, it must necessarily come into use before many years.

Rev. Mr. Shafter, of New-York, observed peat and marl in Rhinebeck, North-East, and Clinton, in 1817. He gave a section of one of the marshes, which is as follows:

1.	Sod and vegetable mould,	
2.	A stratum of turf on peat,	3 to 4 feet.
3.	do peat and marl mingled,	2 "
4.	do pure marl,	2 to 3 "

"Below these was an appearance of sand and blue clay. The peat by drying acquires a high degree of solidity."* It is easily kindled, burns with a bright flame, yields a blueish smoke, and produces an odour similar to that which attends the combustion of gramineous substances.

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* Am. Jour. of Science, I. p. 139.

But this is momentary. When thoroughly kindled, it burns with less flame, yields a small proportion of blackish smoke, and sulphurous acid gas is evolved, though I cannot discover any pyrites. It burns for a long time, and emits a great body of heat. It leaves a very small proportion of light and grayish white ashes. Speaking of burning it, he says, " The attempt succeeded so well, that I cannot refrain from expressing my opinion, that this variety of peat will answer as an excellent substitute for the best Liverpool coal."*

During the surveys of the past season, I have collected specimens of peat from various localities. Some of them, now when dry, are compact enough to receive a slight polish, and have as great a specific gravity as bituminous coal, and would probably give out as much heat.

Alluvions from Solution.

Calcareous tufa is found near the spring which supplies the city of Hudson with water. It is a deposit from the water, which contains carbonate of lime in solution. It encloses sticks, reeds, land shells, as helices, and in fact every substance with which it comes in contact when forming. It is an indurated stony mass. It is not extensive, and shows itself but little on the surface. It was pointed out to me by Mr. S. A. Rowley, a young gentleman who has done much in developing the local geology of Hudson. Calcareous tufa is deposited abundantly from the waters of the New-Lebanon springs.

Tufa is quite common in the limestone regions of Columbia and Dutchess counties.

Calcareous concretions, such as stalactites and stalagmites, and concreted carbonate of lime, of various forms, may be seen in the Spook-Hole, a cave near Barnegat. It is said to be hazardous to enter this cave far beyond its mouth, on account of the carbonic acid gas, which extinguishes a lighted candle, and would destroy life in a short time. Lights burned well, however, when I visited it, as far as I could enter without creeping.

Tufaceous marl occurs in New-Lebanon, on the farm of Mr. Tilden. It is deposited from the spring water, holding lime in solution. Some of this tufa is deposited in a solid form, enclosing leaves, &c. but most of it is in a finely divided form, which can be shovelled up, and is well adapted for a manure. Prof. Briggs, who examined this locality, states

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† Am. Jour. of Science, I. p. 140.

that many thousand loads can be easily obtained, yet it has never been tried as a fertilizer.

The use of tufaceous marl has been already alluded to; stalactites and stalagmites are used for ornamental marbles, and sinter and tufa for making very pure and white lime, for walls of hard finish.

Bog Ore.

Bog ore occurs in the low grounds in the valley of the Kline Kill, three or four miles east of Kinderhook. It was pointed out to me by Mr. Samuel Crocker, on Peter Gardenier's land. It forms a layer of about eight inches thick, under the soil of the meadow. Mr. G. thinks it extensive. The ore is more or less mixed with gravel, but some of it is of good quality. Bog ore is said to occur in the meadows near the Sulphur Springs, in the north part of Claverack. It is also found on the farm of Daniel Falls, and on several of the adjacent farms, in a tract of meadow land. It is supposed to be in too small quantities for extensive use. Some of the ore has been smelted at Kemble's furnace, at Cold Spring, in Putnam county.

Bog ore is said to occur in a meadow two miles west of Pine Plains.

At Poquaick, in Beekman, bog ore is also stated to be found.

Rev. Mr. Woodbridge, of Austerlitz, informed me of a deposit of bog ore, one and a half mile from that place, on the farm of Mr. Asa Calkins.

Iron ore, probably bog ore, is said to exist in Chatham, east of Groat's Corners, on Mr. Burges' farm.

Bog iron ore, although quite common in small quantities in Columbia and Dutchess counties, is not often found there in such bodies, or of such quality, as to be very valuable. The important beds of iron ore will be described under Hematite.

Wadd.

This alluvial ore is found rather abundantly in a narrow range of country in Columbia county. It is deposited from solution in water, in marshes, like bog ore. It has been found in quantity only in the vicinity of a range of slate, injected with quartz veins, which contain brown spar. Where this spar is decomposed, oxide of manganese remains, which frequently retains the crystalline texture of the spar. This quartz, when exposed to the air, soon loses the brown spar by decomposition, and becomes cellular in consequence. The manganese of the wadd is supposed to be derived from the brown spar which has been decomposed, and the constituents of which have been transported by water into the low grounds, where the manganese is deposited. Brown spar is composed of the carbonates of lime, magnesia, iron and manganese; and as these bodies are isomorphous, they may replace each other without changing the crystalline form. The brown spar of this range of rock seems to contain an unusually large portion of manganese. The chemist of the survey, Dr. L. C. Beck, will probably aanalyze it, and the wadd also.

Mr. Merrick, one of the acting assistants, examined a locality of the earthy oxide of manganese, on the farm of Mr. H. W. Gott. The ore is that usually denominated Wadd. It is found in a marsh, and deposited like bog ore. It has been dug to the depth of 5 or 6 feet, but how much deeper it extends is not known. This ore was dug some years since for the New-York market, and sold there at $20 per ton; but in consequence of the small profit derived, the owner abandoned the business. The bed of ore is reported to be extensive, and probably it may contain from 5,000 to 10,000 tons; $20 per ton is probably less than its value.

Mr. Gott's grandfather discovered this ore bed about fifty years ago, but supposed it to be iron ore. A light seen near this spot is said to have led to its discovery.

Dr. Foot, of Spencertown, informed us that another bed of it exists one mile south of the above, on the farm of Mr. Judson Park.

Mr. Merrick found oxide of manganese or wadd about two miles east of Green river, at the outlet of a marsh, near an excavation made for silver ore, but from which little silver will probably be obtained. Many similar localities of wadd are reported to exist in this vicinity, and in the northeast part of Austerlitz.

Wadd was pointed out to us on David Parsons' farm, three-quarters of a mile south of Canaan Centre. It was seen at the outlet of a small swamp, and had a depth of from six to eighteen inches. The swamp has an area of perhaps three or four acres, and is probably underlayed by a bed of this ore of manganese, which has been deposited like bog ore.

A bed of wadd, or earthy oxide of manganese, has been found on the farm of Joseph Goodsell, in Hillsdale. Mr. Calvin Prescot dug fifty tons of this ore several years ago, and sold it for $20 per ton in

New-York. Prof. Cassels reports that oxide of manganese occurs half a mile east of Mr. Joseph Goodsell's; it is inferior in quality.*

It is probable that 50,000 tons of wadd could be procured in Columbia and Dutchess counties, without any great expense, and if carefully prepared would be a valuable article of trade. At $20 per ton it would be worth $1,000,000.

This ore is extensively employed in the manufacture of glass, and of the chloride of lime, or bleaching powder. Large quantities are consumed in chemical factories in New-York and other places. Their supplies are chiefly derived from Vermont and Germany.

Tertiary Clays, Loams, and Marls.

Clay is very abundant and extensively diffused in Columbia and Dutchess counties. It forms the sub-soil, or exists at a greater depth below the gravel and sand beds which form the extensive plains along the elevated banks of the Hudson river, and in the valleys of its tributary streams. There are two kinds, viz. the blue and the gray clay. They are almost uniformly associated with each other, the blue lying below the other. Their line of junction is generally very distinctly marked. They are horizontally stratified, except where slides or some local disturbance has recently taken place. These clays are very fine and free from grit. The gray is striped with numerous thin layers, which vary in color. Mr. Finch notices the occurrences of pyrites and fossil wood in these clays,† but I have not yet observed them.

Both the gray and blue clays are calcareous, effervescing when moistened by an acid, and have been mistaken for marl. They are, in fact, a kind of marl, and marly clay would be a proper name for them. They may be used with great advantage on sandy or light loamy soils. The clay would be a permanent benefit to those soils, while the calcareous ingredient would afford a lime which is considered a necessary element in soils on which wheat is cultivated.

It is believed that the marly clays and clayey marls of the Hudson valley, would be a valuable fertilizer of the soils of Long Island, but experience must determine whether most benefit can be derived, at the same expense, by using clay and lime, or these marls, to dress the soil.

Both the gray and blue clays are extensively used in the manufacture of bricks on the banks of the Hudson river. It is unnecessary to specify particular localities of these clays, as they form the surface, or underlay the gravel beds of the plains of Columbia and Dutchess counties; and these plains probably form one-eighth of their whole area. Their thickness varies from a few feet to 100 or more,* so that they are perfectly inexhaustible, and offer means of profitable industry to many thousands for an unlimited period of time.

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* Oxide of manganese is said to occur near Ancram lead mine. Cleveland's Min. Robinson's Catalogue of Minerals, p. 114.

† American Journal of Science. X. p. 229.

Clay stones, as they are called, are found abundantly in many localities in the upper beds, within fifteen feet of the surface. They are also called indurated clay. They assume a great variety of imitative forms, and nearly all of them have a hole through the centre, from the size of a pin to three or four inches in diameter. Some geologists have supposed them to be fossil remains. Their origin has been long known, however, to some of the people of the Hudson valley, where they may be seen in all stages of their formation. They contain more carbonate of lime than the surrounding clay, and enough to indurate it. They never occur here at greater depths than the roots and fibrous rootlets of plants and trees penetrate. The calcareous matter in solution in the water, is deposited in the clay around the rootlets, while the water is absorbed and serves to nourish the plants.

These clay stones are important in an economical view, for if not separated from the clay in the manufacture of bricks, during the burning they are converted into lime. When the bricks become moistened, either by exposure to the weather or by laying in mortar, this lime slacks and bursts them in pieces.

Coarse pottery is manufactured from the clays of Columbia and Dutchess counties, but it is a branch of industry in which little capital and few persons are employed.

Bricks.

The following table shows the amount of the brick manufactured in Columbia and Dutchess counties:

At Stuyvesant there are four brick yards, at which are made annually from 1,500,000 to 2,000,000.

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* The following section obtained by Mr. Disbrow, in boring for water at Hudson, shews the the thickness of the clay at one point.

	Feet.
Clay,	144
Sand,	40
Hardpan,	30
Gravel,	4
Slate Rock,	
	218

He penetrated seventy feet into the slate rock without observing any change in its character. [*Am. Jour. of Science, xii. p.* 139.]

Between Stockport and Columbiaville, in the same time, about 100,000.

At Hudson, at Mr. C. Mellon's yard, about 2,000,000.

At a yard a few rods below, 1,000,000.

At New-Lebanon, bricks are made, but to what amount was not ascertained.

At Upper Red Hook Landing, from 300,000 to 400,000.

At Walker's Lower Red Hook Landing, 900,000.

Bricks have been made in Chatham, in the valley of Kinderhook creek, but the remains of old kilns only were observed.

In Staatsburg there are brick yards on the east shore of the bay, below the mouth of Livingston creek, about one and a half miles N. E. of a Mr. Emmett's. They make, it is supposed 1,000,000 to 1,500,000.

At Poughkeepsie, both common and stock bricks are extensively manufactured.

At the kilns a little east of the village they burn from 2,000,000 to 4,000,000.

At other yards they burn perhaps 1,500,000.

Charles Vassar is supposed to burn 1,600,000 stock bricks.

Andrew Underhill about 1,000,000 do

Haley, near the Pottery, 800,000 to 900,000 do

These kilns burn, it is supposed, about 3,500,000 stock bricks per annum. They are worth $20 per thousand, thus giving an income of $70,000 annually for this branch of industry in this village.

About one mile north of Barnegat, bricks are burnt, but it is not made a steady business.

There are many places where bricks are occasionally made, but it is believed that the above embrace the most important manufactories of this article.

According to the above estimates about 8,500,000 of common bricks, and 3,500,000 of stock bricks are made annually, and produce an income of from $120,000 to $140,000, for this branch of industry alone.

During the past season, however, less bricks have been made than usual, in consequence of the general stagnation of business.

Slate.

Slate, under various modifications of aspect and texture, is the predominating rock of Columbia and Dutchess counties. The group of rocks included under this general name, possesses a high geological interest, and in some of their forms the rocks are capable of important economical applications. Before entering upon the economical geology of these rocks, I may be permitted to make a single remark upon scientific geology.

Mr. Bakewell, the author of an excellent elementary work on geology, has asserted, that the slate rocks of Great Britain have their cleavage planes inclined at angles of about 60° and 120° with the planes of the strata. Prof. Eaton, and various others, from their observations, adopted Bakewell's views. My own observations led me for a long time to think this was true in the United States, as well as in Great Britain, and it was not until the past season, during which I have examined with much minuteness the slate rocks of Columbia and Dutchess counties, that I have been convinced the rule is not so universal in its application as has been supposed.

The local details, demonstrating that the inclination of the cleavage and strata planes of slate in Columbia and Dutchess counties vary through all angles from 0 to 90°, with the illustrative sections and views, will be given in the final report.

A range of roof-slate extends from New-Lebanon through Canaan, Austerlitz, Hillsdale, Copake, Ancram, and Pulver's Corners in North-East. It is believed to be the same as that in which the Hoosick quarries are located. Quarries of roof-slate have been opened in this range of rock in many places. The most important are those in New-Lebanon, about one and a half miles from the springs on the east face of the mountain. One belongs to Charles B. Gillet, the other, which is about a half or three-quarters of a mile north of the first, belongs to the Rowley family. This last has been extensively worked, but for many years slate has been so cheap as to render the working of these quarries unprofitable. The slate is of good quality, (but softer than the Welch slate) and there is an inexhaustible quantity of it.

At Hillsdale, a quarry of slate was wrought extensively some years ago, by Mr. Foster. The slate is of good quality where it is free from pyrites, but a large portion of it contains disseminated cubic crystals of this mineral. By exposure to the weather the crystals decompose and leave cubic cavities in the slate. The pyrites is an injury to the slate, not only by leaving cavities, through which leakage might take place, after it should be placed on roofs, but by its decomposition, it changes the texture of the slate.*

Many localities were also observed in different parts of this range, at which quarries have never been opened, but which would, undoubtedly, afford roofing-slate of a superior quality. Others, no doubt, might be discovered, should the price of the article justify a further exploration.

Indeed, the quantity of slate, suitable for roofing, contained in this range of mountains and hills, can be estimated only by saying, that it is sufficient to supply a nation's wants for ages.

Siliceous slate is quite common, as a modified form of the slate rocks, from Kinderhook via Hudson to Thompson's Landing below Rhinebeck. It assumes almost every variety of aspect from a common siliceous slate through basanite or touch-stone to hornstone and petrosilex. Good localities may be seen two and a half miles S. W. of Hudson, one and a half miles S. W. of Clermont, several localities in Germantown, and a locality two miles N. W. of Lower Red Hook.

In consequence of the black colour, and thin films of carbonaceous matter, which sometimes traverse it, some persons have been induced to dig for coal where there was not the slightest probability of finding it.

A particular variety of this rock, viz, the basanite, is used as a touchstone by jewellers and others, to test the fineness of gold and silver. There is not demand enough for this mineral to justify any exploration for it.

Other modifications of the slate rocks my be applied to use, as whetstones, both fine and coarse. They occur in Stuyvesant, Stockport, Greenport, Livingston, Germantown, Clermont, and on Rodgers' island. Many stone quarries are worked in the coarser varieties of the slate rocks, which are the proper graywacks. The stone is used for building, for fences, for basement walls, and a variety of uses. The layers are from a few inches to six feet thick, and can be split and dressed as easily as granite. Some of the slaty varieties of this rock form fine flags, and are extensively used in our cities. A quarry of this kind is worked a quarter of a mile east of Lower Red Hook. Many others might be opened in this range of graywacke, which skirts the east shore of the Hudson river, from Upper Red Hook Landing to Hyde Park.

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*About half a mile S. E. of Bain's tavern is an old slate quarry. A quarter of a mile north of Pulver's Corners, in North-East, roof-slate from the same range, containing cubic cavities, is used as a fire stone. This kind of rock, laid edgewise, is generally used for the lining of furnaces in that part of the country.

The varieties of this rock which have been quarried are interstratified in many places with slaty graywacke, graywacke slate, graywacke shale, brecciated limestone, compact limestone, argillaceous limestone, and a calciferous graywacke.

Some of the talcose slate rocks contain much plumbago, and may be called plumbaginous slate. It is frequently seen on Hancock mountain near New Lebanon Springs. It has been used to diminish the friction of the wheels of carriages.

Roof slate is frequently carbonaceous and passes into graphic slate. A locality of this slate is in the road near Mr. Asa Pelton's, and near the line between Austerlitz and Hillsdale. It had been described to us as a locality of black oxide of manganese. This variety of slate also occurs on the mountain one and a half mile south of Hillsdale, in Ancram, one-half mile to one mile west of the lead mine, and in many other places, but is not so black in these two last localities as in other places. It breaks out in columnar fragments. Much of this columnar slate is similar to pencil slate, and might probably be applied to this use.

Many of the slate rocks of Columbia and Dutchess counties are so loaded with carbon, either disseminated or in thin films of anthracite, which fills the natural fissures, cleavages, and breaks of the rock, that many persons have expended time, labor and money in digging for coal.

Too many adopt the plausible idea that if a little of the mineral which is sought be found on or near the surface, extensive beds must necessarily be found below.

Some of the localities where excavations have been made are well calculated to deceive those who are not professional geologists and mineralogists. In some of them, small layers and lumps of anthracite are actually seen; in others, the rock breaks into irregular fragments which are invested with a film of this combustible, and the fragments present an aspect somewhat similar to the carbonaceous matter near the out cropping edges of beds of anthracite. In some localities vegetable remains are found, and the slate is glazed with films of brilliant anthracite. Mr. Conrad, the palæontologist of the survey, is investigating these fossils. There are, at least, five species of fucoides, among which Mr. Conrad recognizes the fucoides dentatus and fucoides serra. One species of trilobite, which Mr. Conrad will describe, was also found in the fissile slate, which it is proposed provisionally to call graywacke shale. About one mile south of Hudson, an excavation has been made for coal during the past year. Mr. Rowley pointed it out to me, and informed me of the fossil remains in the shale. Some of the rocks might be mistaken for coal by those who are not minutely acquainted with coal and its varied aspects. The slate is highly impregnated with carbon, the fissures being filled with thin films of anthracite, and small pieces of this combustible of the size of a pea are not uncommon. This slate strongly resembles the impure anthracite and anthracitic shales of some of our coal mines.

At Rider's mills, both the slate and limestone are glazed with anthracite; and these materials having been excavated from a mill race, induced high expectations of the value of the coal mine that was believed to lie below, and which was supposed to be bituminous coal. Mr. Rider was offered a large sum for his farm, which he refused in consequence of the supposed value of the mine.

Two excavations have been made for coal near the line between Canaan and Austerlitz, one on the farm of Elisha Lord, in Austerlitz, the other on Joseph Olmstead's land, in Canaan. At one of these places, a company in New-York expended $1,100. They bored about 100 feet, and in that depth passed through five inches of carbonaceous or plumbaginous slate. The rocks of these hills are talcose and chloritic slates. The nature of these rocks is a sufficient index to the geologist to judge, that it would be a geological miracle to find workable beds of coal in them.

On the east bank of the Hudson river, two and a half miles below Poughkeepsie, an excavation has been made in the slate rock for coal. A quartz vein intersects the slate, and in this, pieces of anthracite of the size of a pea are found. This vein has been followed down many feet, with the expectation of finding this combustible. It is scarcely necessary to remark, that masses of workable coal have never yet been discovered *in veins traversing the strata.*

At another locality, near Poughkeepsie, a well has been bored 200 feet in search of coal. Excavations have been made in ten or twelve places in the vicinity of Poughkeepsie, and from $5,000 to $6,000 have been expended in search of this combustible. Many believe that coal exists at a considerable depth. A large piece of anthracite is said to have been found at the mouth of Wappinger's creek, about fifty years ago. This fact, the black color of the slate in many places, and the films of anthracite which frequently glaze its surfaces, have nourished the hopes of those who ardently wished that coal might be found there.

In Fishkill, on the farm of Mr. Annan, is an excavation which has been made in expectation that coal would be found. It is in black slate, glazed with anthracite, and would be more likely to deceive those who are not familiar with coal regions, than any I have seen, except those of Hudson, and Rider's mill, in Chatham. This place has been called the coal mine for a century. It is at the base of the Highlands, and very near the junction of the granitic and slate rocks.

Many localities might be mentioned, but these are sufficient to indicate the general character of the coal mines which are so often described in our newspapers as important discoveries, by the fortunate finders or speculators. I am unwilling to say that coal will *not* be found in quantity in the group of slate rocks of the Hudson valley, but I think it improbable that workable beds will be discovered in Columbia or Dutchess counties, and I would advise, that before any considerable expenditures be made in any locality where coal or other valuable minerals may be supposed to exist, that a professional geologist, who is competent to judge, should examine the locality. Such a course would, in numerous instances, have saved much money which has been invested and expended on unproductive property.*

Limestones and Marbles.

The limestones of Columbia and Dutchess counties are very extensively distributed, and are only beginning to attract the attention of the inhabitants to their value and their varied uses. They will form an inexhaustible source of wealth to the community.

The limestones of these counties belong to four distinct geological epochs. The most recent of these limestones is that forming Becraft's mountain and Mount Bob, near Hudson. These mountains, (as they are called, although they are but moderately high hills,) are formed of several beds of limestone, which vary in their mineralogical and zoological characters.† Mount Bob and Becraft's mountain are outliers of

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* I feel it my duty here to expose the conduct of an individual named Adsett, who, during the past year, travelled over a part of Columbia county, pretending that he was one of the geologists employed by the State. In repeated instances, it is stated, he has taken leases of land, and then pretending to have discovered valuable mines, sold out the leases. He has thus swindled persons of various sums, amounting in the aggregate to some hundreds of dollars at least. He is believed to be the same man who induced the company in New-York to bore and dig for coal in Canaan and Austerlitz. Some similar circumstances have been made known in Ulster county, in relation to lead and other mines. It is not known whether the same individual was concerned in these.

† Mr. Conrad is investigating the fossil remains of those rocks, and the scientific discussions in relation to these formations, will be contained in the final report.

limestones, lying unconformably upon the subjacent slate rocks. I have traced these rocks to within a few feet of their junction in many places. Over a large part of Becraft's mountain, the strata slope from 1° to 6°, both from the east and the west, towards the centre of the mountain, forming a very small segment of an inverted arch, and as the limestone is cavernous, and intersected by numerous fissures, most of the water which falls upon the mountain sinks into them and is retained. This peculiarity gives rise to a large limestone spring, which breaks out from the cliff on the north end of the mountain. It affords a constant and abundant supply of wholsome water for the city of Hudson.

The lower beds of limestone of Becraft's mountain, are compact, and of a dark blue, or nearly black colour. It breaks with a conchoidal fracture, is easily dressed with a hammer, and is used for a building stone. It is beautiful and durable. The new Presbyterian church in Hudson, is built of this material. Quarries have been extensively wrought in these beds, on the west side of the mountain. It has also been used for making lime.

The middle beds of Becraft's mountain are slaty limestones, and filled with fossil remains. Some layers are suitable for building, but generally they are adapted only for common wall stone. Some of the strata would probably make hydraulic cement.

The upper beds of limestone in this mountain, are distinctly crystalline, and replete with fossil remains. There are several quarries in these beds near the summit of the mountain. The stone is mostly employed for rough wall stone, for basement walls, and some of it has been used for making lime, for which purpose it is well adapted. This stone receives a high polish, and makes a beautiful gray marble with a tint of red. I have seen chimney pieces which were made of this material that were very beautiful. Mr. Charles Darling, of Hudson, wrought one of the quarries as a marble some years ago, but the demand was not sufficient to justify its continuance. The following description is an accurate one, as might be inferred from the distinguished author of it, Prof. Silliman.

"The marble is of a grayish colour, with a slight blush of red; its structure is semicrystalline, and in some places highly crystalline, especially in and around the organized bodies, which in vast numbers it embraces. Among them the encrinite is very conspicuous and frequent, and when the marble is polished, the organized bodies congealed in a bright calcareous bed, and often more brilliant themselves than the medium at which they are fixed, give it a very fine effect. This is particularly true in large slabs, which present a great diversity of appearance, and could scarcely be distinguished from the similar transition marble of the Peak of Derbyshire, which it greatly resembles, and quite equals in beauty and firmness."--[*Silliman's Journal*, VI. *p.* 371.]

Interstratified Limestones, Compact, Sparry and Brecciated.

The next series of limestones is interstratified with the slate rocks, which form a large part of Columbia and Dutchess counties. These limestones are argillaceous, fissile, and interlaminated with the slate in some places; at others it forms beds of twenty to fifty feet thick of solid blue compact limestone, checquered by narrow veins of calc spar, traversing it in various directions; in other places it is a conglomerate, formed of rounded or of angular masses, cemented by an argillaceous or calcareous matter, which varies according to the nature of the contiguous rocks.

No fossil remains have been observed in these limestones, except a few which occur in a thin layer of this rock interstratified with slate, about one and a quarter miles above Barnegat, on the shore of the Hudson river.

The limestone beds which are traversed by veins of calc spar, have been very justly named, by Prof. Eaton, sparry or checquered limestone; names which, in many localities are descriptive, and involve no theoretical considerations. This rock, as well as the conglomerate limestones of the Hudson valley, will probably afford valuable quarries of ornamental marble.

Very numerous localities of these rocks were seen; a few only of the most important will be mentioned. The black and sparry black limestone abound at Rider's mills, in Chatham, (where they are frequently glazed with anthracite,) also at Malden; on the east side of Kinderhook lake; between North Chatham and Malden; and near Canaan Centre.

The conglomerate limestone is seen at great advantage at the stone quarries in the north part of Stuyvesant, on the banks of the Hudson, and for a mile south it forms the upper layer of the bank of the river. At Great Nutten Hook it is interstratified with slate and limestone, and sandstone, which are also interstratified in this group of slates. It may be seen also two and a half miles southwest of Hudson, on the road to Oak Hill ferry; in a ridge of hills northwest of Johnstown, about four and a half miles from Hudson; one and a half miles south-southwest of Clermont, a little west of the post-road; on the post-road about one and three-quarters of a mile south of Kinderhook; in Ghent, six miles south-southeast of Kinderhook, on the west side of the creek; in the east part of Kinderhook; also in Clinton, on land of Joseph Le Roy. In the east part of Rhinebeck, and four miles east of Rhinebeck village, Mr. Merrick states that the brecciated limestone occurs.

Barnegat Limestone.

The first continuous range of limestone of much magnitude that is seen in Columbia and Dutchess counties, in passing from west to east, is that which crosses the Hudson at Barnegat. It extends from Barnegat up Wappinger's creek, by Pleasant-Valley and Pine-Plains into Columbia county, and on the south it passes from Milton to Newburgh, on the west down the great valley through New-Jersey into Pennsylvania. Wappinger's creek forms the eastern boundary of this limestone range to near Attlebury. It crosses the valley of Pine-Plains under the Great Peat and Marl marsh and Stessing pond. Mount Tom, at Copake Flats, is probably a continuation of the same limestone. It varies in its characters from a sandy granular subcrystalline texture, to a perfect compact limestone, with a conchoidal fracture. This limestone is usually gray, granular, and sub-crystalline, with grains of sand and minute quartz crystals disseminated. Small cavities lined with quartz crystals are common.

It is said to contain fossil remains, but they must be very rare, as I have not been able to detect a trace of one. It is sometimes distinctly stratified, and even slaty near its junction with the slate rocks, but frequently its beds are so thick, and the masses of the ledges so broken, that scarcely any traces of stratification are visible. This limestone is important, in consequence of its extensive application to the manufacture of lime.

This business is not carried on extensively in Columbia county, but in Dutchess, at and near Barnegat, much lime is made. The facilities for this manufacture are greater at this place and about Milton, on the right bank of the Hudson, than at any other part of my district. The limestone rock forms the banks of the river at these places, and they are located at a short distance from the Delaware and Hudson canal, where coal can be had cheap, and delivered at the lime kilns.

The lime kilns at Barnegat are kept burning constantly, from the opening of the river in the spring until the closing of it in winter, without allowing them to cool. The method pursued here is, after the kiln is once kindled, to charge about a half a ton of anthracite coal broken to the egg-size, then 300 to 350 bushels of limestone in lumps of 20 to 30 pounds each, and at the end of 12 hours another charge of coal and limestone, and so on, until the kiln is filled. They then draw out about 350 bushels of lime from the bottom, and introduce another charge of coal and limestone, and every twelve hours this process is repeated. This operation is continued for months, as in a high furnace for smelting iron. A great economy is thus introduced,* the kiln being always kept heated, and the caloric which would escape in the common mode of manufacture, is here expended in heating other portions of limestone, and preparing it for the high temperature necessary to expel the carbonic acid. About 700 bushels of lime are thus obtained daily from each kiln, with a consumption of a little less than a ton of coal.

Coal is delivered at the kiln at $6 per ton, so that the expense of fuel is less than one cent per bushel, and that of attending the kilns does not exceed one cent more, and the expense of raising and carting the stone is very trifling.

Lime is sold on the wharf at 6¼ cents per bushel, and vessels are always waiting for their cargoes, and take the lime as fast as it is burned.

This manufacture is the only business of any importance in Barnegat; six kilns are in constant operation, and there are others in the vicinity. About 6,000 bushels are burnt per diem for nine months in the year, equal to 720,000 bushels per annum. There are numerous other lime kilns in Dutchess county, and it cannot be far from the truth to estimate their annual product at 1,500,000 bushels. This at 6¼ cents per bushel would yield an income of $93,750, and a nett profit of at least $30,000.

This lime is not as strong as that of Thomaston or Rhode Island, and does not make as white walls. Most of the lime made at Barnegat is employed as a manure in New-Jersey on their sandy soils, and it is found to be an excellent fertilizer.

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* The relative economy introduced by this method of burning, may be calculated form the fact that in Connecticut, where lime is burnt with wood, and the kilns allowed to cool between each burning, 35 cords of wood are employed to burn 700 bushels at Brookfield, and 40 cords to burn 1,200 bushels at Reading.* Allowing wood to be worth $2.50 per cord, the expense of fuel for burning is 12½ cents per bushel in the first, and 8⅓ cents in the second case. The perpetual kilns of Pennsylvania yield 700 bushels of lime for every eight cords of wood, and one and a half tons of Anthracite consumed.† In New-York 2,000 bushels of lime are burnt with 12 cords of wood.‡ We see here a striking example of the variable quantity of combustible to produce the same effect, and how great a saving may be made in this manufacture by judicious management. We have no knowledge of any lime kilns that employ so small a quantity of combustible as those of eastern New-York.

*Shepard's Mineralogical Report of Connecticut, p. 82. †Idem, p. 87. ‡Idem.

Granular Limestone—Marble.

The granular limestone of Columbia and Dutchess counties is very extensive, and does not yield to any other mineral deposit in those counties, in prospective value. Marble quarries are extensively wrought in some parts of this range of limestone, and many others will undoubtedly be opened. The limestone extends through the greater part of the length of these counties, and crops out with a variable breadth from a few hundred yards to several miles. It varies much in texture and colour. It is granular and compact, white, gray, clouded, striped, and nearly black. In some localities it is strong and difficult to break, in others it is dolomitic and very friable, and crumbles to sand by exposure to the weather. The limestone beds of this range are interstratified with talcose and micaceous slate. They dip to the east and E. S. E. from 20° to 90°. It is rarely used except as a wall-stone. Lime has been made from it in Amenia and some other places. It makes a strong and good lime.

The only marble quarries which are extensively wrought in this range of limestone in Dutchess county, are in Dover. The principal quarries are those of Ebenezer Stevens, Elder Foss, John Ketchum, and Nailor Wing. These quarries average about 8,000 feet of white marble slabs per annum. Hess' quarry is three-quarters of a mile north of Stephens,' Ketchum and Wing's, one mile east of Stephens'. It is estimated that from 20,000 to 40,000 feet of marble slabs are sent from the town of Dover in a year, and yield an income of from $15,000 to $30,000 per annum. In the marble mills, a frame of 16 saws will saw out about 200 to 250 feet per week. The Dover marble is almost a pure white, fine grained, dolomitic limestone. It works easily, and takes a medium polish. It is nearly all used for grave-stones, and sent to most parts of the United States. Quarries might undoubtedly be opened on the west side of the Dover valley of as good marble as those on the east. Near Kline Corners and Hitchcock's Corners, are extensive beds of limestone which do not crumble by the action of the weather, and which would make a good marble. In Hillsdale, on Mr. Palmer's land, is a white and clouded marble. It exists abundantly along the base of the mountain.

In Beekman, near Doughty's mills, fine marble, in beds of a few feet in thickness, were observed, as also in several places in Fishkill, near Stormville and Hopewell.

Clouded marbles were observed by Mr. Merrick, on the lands of Mr. Worster Wheeler and E. Merritt, in North-East. The locality on the land of Mr. M. was worked as a marble quarry 20 or 30 years ago, but has been abandoned. It is a beautiful clouded gray marble.

Other quarries have been worked in several places to a small extent, but the demand for the particular kinds was not sufficient to make them profitable.

Marble was sent to the New-York market some years ago from New-Lebanon, which sold for $1 per square foot. Six quarries were opened in that township, and from one of them slabs 14 feet in length were obtained.* The limestone beds of New-Lebanon and Hillsdale are interstratified with talcose and talco-argillaceous slates, and seem to pitch under the mountains on the east, which are talcose, mica and chloritic slates. The Stockbridge and Egremont beds, which have many points of resemblance, seem to overlay these same rocks.

The value of the marble quarries in Egremont, Stockbridge, &c. is well known. They are almost as important to our citizens as if they were located within our own boundaries. Their products are entirely sent into our territory and shipped from our ports; and these, together with those of Dutchess county, are supposed to yield about $100,000 per annum.

Beds of marble, as good as those of Stockbridge and Egremont, undoubtedly exist in Hillsdale and Copake, in Columbia county, west of the mountains, and in North-East, Amenia, Dover, Pawlings, Beekman and Fishkill, in Dutchess county. The occurrence of beds suitable for marble *west of the mountains*, is important, in consequence of the diminished expense of transportation to tide water on the Hudson. The marble trade is already an important branch of industry, and in our territory it must necessarily be one which will rapidly increase in value and importance. The marble beds here and in Westchester county are more convenient to water transportation than in other parts of the United States, where the marbles are of similar quality. The strata also are thicker, and blocks of almost any desired magnitude can be quarried. The large blocks for the columns of the Girard College, in Philadelphia, are quarried in Egremont, Mass., very near the line of Massachusetts and New-York. The marble business is one that will always employ many men and much capital, and this valuable material is so abundant that it is perfectly inexhaustible in any finite period of time, and it will always be an unfailing source of wealth. I consider the resources of

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* Silliman's Journal, V. p. 10.

Columbia and Dutchess counties, in valuable marbles, as inexhaustible and incalculable.

Granite, Gneiss, and Granular Quartz.

Granite and gneiss, and various modifications of these rocks, form the mountains in the south and southeast parts of Dutchess county. There are many places where quarries may be opened, which would afford building materials of the best quality, and which would endure the changes of our variable climate for ages, without decay or disintegration. The naked crags and masses of rock afford irresistible evidence on this point. These rocky hills and mountains, worthless as they now seem to most persons, undoubtedly contain the best of building materials. The quarries which will be opened will form an important branch of industry, and will enable our citizens to construct both our public edifices and private dwellings of our own native materials, and which are as durable and beautiful as those now brought from Maine, Massachusetts, and Connecticut, at so great an expense.

The discussion of these rocks in detail will be left until the next annual report, when they will have been fully examined. They form the main rocky masses of Putnam and Westchester counties, but occupy a small area in Dutchess county, so that but a small portion of these mountains have been investigated as much in detail as their merits require.

Mount Stessing, near Pine Plains, in Dutchess county, is an isolated mountain of gneiss and granite, which are perfectly similar to those of the Highlands. Its strata are nearly vertical, and dip to the eastward, except in one or two localities, where they lean a little to the east. There are some beds of rock suitable for building stone, but the mountain is so located that it is not probable they will be of any value.

The slate rocks, very much dislocated and upturned, form the western, and the Barnegat limestone range the eastern boundary, of this mountain. It stands perfectly isolated, like an island in the sea, surrounded by other rocks, and in a country comparatively level for a few miles around, except on the west, where the upturned slate rocks form a labyrinth of small hills.

Granular quartz rock forms a mountain mass in the east part of Dutchess county. A part of Peaked Mountain and Elbow Mountain are formed of this material. It varies much in its texture and colour, but some of its beds will probably make a good fire-stone, and others are adapted for the manufacture of glass. No localities were observed where extensive quarries for these purposes could be opened; but from the examinations made, there can scarcely be a doubt that they may be found. This rock is probably a continuation of that in Massachusetts and Vermont, described by Prof. Hitchcock, in his Geology of Massachusetts.

Springs.

The springs of Columbia and Dutchess counties contain earthy salts in solution in variable quantities. Some of the deposits of calcareous tufa and sinter, tufaceous marl, bog ore, and wadd, have already been mentioned.

The shell marl of the swamps and ponds had a similar cause of deposition, but was first secreted by moluscous animals, to form their covering shells.

The water of the talcose rocks is much more pure than in the limestone, slate and clay districts, and it is probably as pure water as can be found, except rain water.

It is expected that the analyst, Dr. Beck, will make known the composition of the waters of the State. Copious limestone springs are frequently seen in those two counties, and some of them are of a size sufficient to turn a mill. The spring at Hudson has already been mentioned. Another occurs at low water mark on the bank of the Hudson, a half or three-fourths of a mile north of Barnegat. Another flows from the side of the post road, a quarter of a mile north of the crossing of the Caspar kill. Another, on Judge Bockee's farm, in North-East, delivers about 20 cubic feet per minute. The water is very clear, and uniform in temperature through the year.

In Pine Plains are several large springs. Two are located on Mr. Walter Reynolds' farm, about three miles east of Pine Plains. Both of them are, in fact, subterranean streams, which sink into the earth and re-appear. The larger stream disappears in a sink-hole in the base of the hill, on the north side of the road from Pine Plains to Pulver's Corners, and re-appears as a large spring boiling up through sand about a quarter of a mile southwest of the place of its disappearance. There is a sink-hole on the line between these places, where the earth sunk in a few years ago. Mr. Reynolds, who has done much to develope the local geology of that vicinity, pointed out these and many other interesting geological facts.

Another stream vanishes and re-appears twice, south of the above, and a line of sink-holes indicates the course of the subterranean stream. One of them sunk a few years since, carrying a cow and a tree. The tree still lives, but its limbs and top only can be seen at a little distance. The cow, being unable to climb out of the sunken ground, starved to death.

On Becraft's mountain, a small stream disappears in a sink-hole, and re-appears as a spring, at the base of the cliff, on the east side of the mountain.

Cold Spring, southwest of Stessing mountain, flows from the base of a limestone ridge. A brook flows from it large enough to carry a mill. It is generally reputed to be the subterranean outlet of a small lake at the base of Mount Stessing, and which has no visible outlet.

The Clove Spring, as it is called, in Verbank, is supposed to discharge from twenty to thirty barrels of water per minute. The water is very limpid.

Gaseous Springs.

The New-Lebanon spring is well known; it delivers 16 barrels of water per minute of the temperature of about 72° or 73°. It rises from near the junction of the talcose slate with the limestone, and there are some traces of a fault in the vicinity.

A gas spring rises in the bed of a small stream a quarter of a mile from Ameniaville, on the road to Poughkeepsie.

Another is stated by Judge Bockee to exist on Isaac Smith's farm, one mile S. E. of his house in North-East.

Two others were observed in New-Lebanon, by Prof. Briggs, one on the road to Stephentown from Lebanon Springs, and the other on Mr. McNaughton's farm, between the Shakers' Village and Lebanon Springs. The temperature of these waters was not taken, but it is said they do not freeze in winter.

Chalybeate Springs.

Near Upton's pond, in Stanford, Mr. Merrick observed a small chalybeate spring, from which an unusual quantity of iron ore is deposited.

Near the village of the Brick Yard Shakers, in New-Lebanon, Prof. Briggs observed the water of a spring highly charged with iron, and ore is deposited in small quantities, and also in the vicinity of the Alum Rock, so called, north of Lebanon Springs. Two miles south of the Shaker village Prof. B. observed the spring waters, on the east side of the road, tinged with iron. In several places near the road, south of Mr. Bailey's, in New-Lebanon, a reddish deposit was made by the spring waters. Ferruginous matter is deposited from water near Mr. Grant's in New-Lebanon, on the east side of the valley, and three-quarters of a mile from the turnpike.

A small chalybeate spring was seen on the east side of the road, half a mile south of Canaan Centre.

Another was observed two miles N. E. of the Lutheran meeting house, in the town of Milan. It is on the land of John J. Link.

Mineral springs are said to occur on Peter Hoosis' and on Mr. Warterburgh's farms, in Stuyvesant.

Another, on the left of the road from Kinderhook to New-Concord, near the latter place.

A chalybeate spring is stated to flow from the base of the mountain half a mile N. W. of Kline Corners, in Amenia.

Sulphur Springs.

A spring of this character flows from the base of the terrace next the meadows on the Best farm, about one and a half miles north from Kinderhook. It probably flows from the gray clay, or from the junction of this, with the blue clay. Other springs of a similar character are said to rise in the adjacent marsh, and also in a marsh south of Kinderhook valley.

Another occurs near the line of Claverack and Ghent, one mile east of Miller's tavern. Mr. Livingston, of Oak Hill, in Livingston, Columbia county, informed me of a sulphur spring about a quarter of a mile east of his house.

A small sulphur spring flows from the base of the mountain about a mile and a quarter N. N. W. of Ameniaville, on the land of Mr. Thomas Ingraham. It contains very little sulphuretted hydrogen, and sometimes its odour is so slight as to require to be taken in the mouth to perceive that it is a sulphuretted water. Most hepatic springs spread a strong odour around them. This spring has some celebrity, as well as that at Kinderhook, and the Columbia spring, near Hudson.

Prof. Briggs observed a sulphur spring on Mr. McNaughton's farm, between Lebanon Springs and the Shaker Village.

Plumbago.

This material occurs in several places in the granite rocks of the south and S. E. parts of Dutchess county, in small quantities. A mine of it has been opened in the mountain south of Fishkill Landing, on the farm of Mr. Peter Dewint. Some tons of plumbago have been extracted and sent to market. Mr. Merrick, who examined the mine, reports favorably on its probable extent, and the quality of the material. Another mine was ascertained to exist at Fishkill Hook. The plumbago forms a bed of two to four inches wide. Both these mines are said to be in gneiss.

Black lead, or plumbago, is common in the talcose and talco argillaceous rocks of the Willlamstown mountain range, in Hancock mountain east of New-Lebanon, and east of Hillsdale. (One place has been opened two miles east of Hillsdale.) It is reported by Professor Cassels to be a mixture of talc and plumbago. This has been used on the axles of carriages to diminish friction, and it is said to be well adapted to this use. It is not improbable that it may be found in quantities in this range of rocks, and pure enough for exploration.

Lead, Copper and Zinc Ores.

Galena, or the sulphuret of lead, is extensively distributed over a tract extending through Columbia and a part of Dutchess counties. In nearly every locality where I have seen it, it is situated in veins, traversing the strata near the junction of limestone with slate rocks.

Although numerous localities have been examined, none were seen where it is deemed advisable to expend much money in prosecuting mining enterprises; still, it is thought highly probable that valuable mines of this ore may be discovered.

The lead mine which has been most extensively wrought, is the Ancram, or Livingston mine, in Ancram, Columbia county. Dr. Beck described the mineralogical characters of this mine in the report of last year. The mine was filled with water when I saw it, of course I could not examine into its minute geological features as accurately as I wished. It is situated in a talco-argillaceous and calcareous slate, a little west of its junction with a limestone, which is a perfect type of Prof. Eaton's sparry limerock. The adit, which has been partly excavated, with a view to drainage, penetrates this rock for 60 feet or more. The vein, which is of quartz, containing galena, blende, copper, pyrites, &c.

is about four inches wide at the surface, and widens downwards, but is very irregular in width, and branches off into bunches and strings. It is nearly vertical, and ranges south 70° west, and north 70° east. The strata dip eastwardly 60° to 70°. The ores from this mine, when mixed, are said to yield 118 ounces of silver to the ton.*

The next most important localities noticed were in North-East, about five miles S. E. of Pine Plains, on the farms of Judge Bockee and Mr. Ward Bryan. Many openings have been made on these farms, and lead in some quantity has been procured from them. These mines were worked about 1740 by a company of Germans, and the ore was sent to Bristol, England, and Amsterdam in Holland. The ore is said to yield 45 ounces of silver to the ton. It was not profitable, and was abandoned. During the revolution they were re-opened by Peter McDaniels, under the direction of the committee of safety of Congress, with a view to supply the army with lead. Some tons of it were procured, but as the mines were abandoned, it is presumed they were not productive. The veins cross the strata in a direction nearly west and east. At one of the openings, about half a mile S. W. of Judge Bockee's on Mr. Ward Bryan's farm, we took out 40 or 50 pounds in an hour, from a vein about an inch wide. This ore is very pure, and will yield about 80 to 85 per cent of lead, and it is said to contain some silver. The vein is too narrow to warrant mining, unless one depends upon the doctrine of chances.

Many small veins were seen in the limestone north of this opening in the bed of the brook, and which contained particles and masses of several ounces, and even pounds weight of pure galena.

The excavations on Judge Bockee's land, which extend south from those above mentioned, and continue at short intervals for half a mile, show numerous small veins of galena, all of which contain black sulphuret of copper, with some yellow copper ore (pyritous copper) and green and blue carbonates of copper. All the openings are in the limestone, (which is of a blueish gray, nearly compact,) and a few rods east of its junction with the slate on the west. The great number of small veins in this vicinity renders it highly probable that larger ones occur, of which these are mere strings.

The lead veins, called also silver mines, of Canaan, have attracted some attention. They are located near Whiting's pond, perhaps one or two miles south, and not far from the "Yellow Meeting House." One of them lies on the east side of the road on the hill, in limestone, and the other appears to be in quartz veins, which traverse the strata. It could not be examined without some difficulty, as the shaft was filled with brush. Fragments of quartz and ore were scattered at the mouth of the mine. The ore is a mixture of fine grained galena and yellow blende. Fragments of several inches in diameter were obtained, showing that the vein was several inches wide, in some parts. The ore is said to be rich in silver, and to have been worked a half a century ago by some Germans as a silver mine. Numerous small veins of galena are reported to occur in the vicinity, and Mr. Calvin Prescott, of Hillsdale, informed me that he had seen galena in many places in the limestone ledges on the farm of Capt. Burr, on the east side of the road near the same place, near the Hudson and Albany rail-road, and a few rods south of the silver mine, so called, on the land of Calvin Pease. Black and yellow copper ores (sulphuret of copper and pyritous copper) occur in small quantities, associated with the galena.

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*Cleaveland's Mineralogy, p. 633.

Near the localities mentioned above, is a reputed silver mine. It has been opened within a year or two. It is leased by Elder Ford and Mr. Holmes. Elder Ford showed me 300 or 400 lbs. of the ore. It is disseminated through quartz, and unless it be very rich in silver, would not pay the expense of picking, stamping, washing and smelting. I examined the mine, and found small quartz veins traversing the limestone in an east and west direction. A single particle only of the galena was observed, which would not weigh more than 40 grains. There are no indications, to my mind, that would justify a mining enterprize. Superstition, as in many other instances which have come under my observation, has been busy. This mine is stated to have been discovered in a dream, by an apparition pointing out this as the locality of a rich silver and lead mine, to a Mr. Holmes, the father of one of the lessees, about 30 or 40 years ago. He sold the farm many years since, went to the west, and after an absence of more than 20 years returned, took a lease of the lot, and opened the place where he had dreamed a rich lead and silver mine had been indicated to him. He gave one half his interest in the mine to his son, and sold the other half. It has been worked within a year, and the lessees will probably continue to work it.

Mr. Calvin Prescott, of Hillsdale, who has long been a close observer of the minerals of that region, imparted to me the following localities where small quantities of galena have been found. Several of them were examined by Prof. Cassels and Mr. Merrick, in company with

Mr. P., but there are no indications worth pursuing for mining purposes.

Fine grained galena is found in Dover, in a small vein in dolomite, near John Preston's inn.

Galena has been found in Hillsdale, on land of Uriah Sornberger, Andrew Shortis, David Collins, Richard A. Wheeler, Sylvester Williams, and John F. Collins.

These are all situated in quartz veins which traverse the limestone, and the ore is disseminated in small grains and bunches.

On the road from New-Lebanon to Stephentown, a lead mine is said to exist; but Prof. Briggs, who examined the locality, could trace no appearance of lead ore.

Lead ore is said to occur in Amenia,* but I could learn nothing in relation to it from the inhabitants. A vein of galena is also said to have been found in Claverack† and at Rhinebeck.‡ Another was reported to occur in Ghent, where lumps of the size of a person's head were easily obtained, but I could not ascertain its exact locality.

Mr. Staats, of Hudson, informed me of another locality in Ghent, on the farm of Martin Harder.

A small string of galena is stated to have been found in digging a vault on the east side of Indian Pond, in limestone. The vein traversed the rock from east to west.

In Stanford, lead ore is said to occur on the land of Asa Thorne, and also on that of Asa Thompson.

Copper ore in small quantity was observed on Gen. Brush's farm, in Amenia. This locality was worked for copper ore some twenty years ago. It is about 100 rods west of the City meeting-house.

Copper ore, principally of the black sulphuret, has been mentioned in Judge Bockee's lead veins, in North-East. It also occurs in New-Canaan, Columbia county, on land of Daniel Pease. Mr. Prescott, who mentioned this locality to me, states that it contains copper, lead and silver. Mr. P. also observed a small vein of pyritous copper on the farm of John F. Catlin, of Austerlitz, in veins of white quartz, traversing limestone; also on the mountain east of Green river, about a quarter of a mile from the inn formerly kept by Hatch. Mr. Prescott says this is the blue copper ore, in a narrow vein, and that a similar one occurs in Hillsdale, on the farm formerly owned by Mr. Jesse Squire. Copper pyrites occurs rather abundantly in the Ancram lead mine, but not enough to be worth separating.

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* Cleaveland's Min. p. 633, and Robinson's Catalogue of Minerals.
† do do 633. ‡ Idem, p. 633.

Copper pyrites was observed in the siliceous slate, on the road from Lower Red-Hook to Upper Red-Hook Landing, but in small quantity. It is on Nathan Beckwith's land.

Galena has been found in several localities in New-Lebanon. Lead ore occurs in an old mine in Livingston, on the farm of John E. H. Plass. Pyrites and blende are also associated.

Another mine hole is seen about 150 to 200 yards southeast of the one just mentioned. The hill in which they are contained is called the Red Hill, in consequence of the deep red colour of the soil. The ore is contained in a stratum of rock resembling compact trap. It is about two or three feet thick, and dips 30° to 40° to the eastward, parallel to the slate.

In Fishkill, on Mr. Van Wyck's farm, one mile southeast of Johnsville, Mr. Merrick saw a thin vein of quartz in limestone, which contained galena, and some copper pyrites.

Blende occurs abundantly with the lead ore at Ancram lead mine. It is both yellow and crystalline, brown and compact. It was also seen in veins one-quarter to one inch wide in the limestone at Mr. Ward Bryan's, and Judge Bockee's lead mines, in North East. It was seen in small quantities at most of the lead digging in various parts of Columbia and Dutchess counties, but more abundant and beautiful at the old "silver mines," in Canaan, two miles south of Whiting pond.

In North-East, on Mr. Lee's farm, about four miles north of Amenia, are excavations made some years since in search of silver. They are in quartz veins in the talcy slate rock, near the junction of this rock and limestone. Pyrites occurs in some abundance there, but no other ore was seen.

In the northeast part of La Grange are numerous excavations, said to have been silver mines, from which, according to tradition, large quantities were obtained in olden times. Mr. Merrick could discover no traces of any metal except a few particles of pyrites, and the money made there was probably " out of pocket."

Silver mines have often been mentioned to me as occurring in particular localities, but investigation showed, in at least nine cases in ten, that pyrites was the deceptive mineral. A silver mine is reported to exist in Hillsdale, on Barney Overhizer's farm. It is probably pyrites.

Too many are still believers in the mineral rod, and suffer themselves to be duped by the designing; but there are some who *use* the mineral rod and are ignorant of the cause of its motion, who firmly believe in its virtues. It is time that this faith in the mineral rod should be exploded.

Iron Ores.

The iron ore of Columbia and Dutchess county is very abundant, and makes iron of the best quality. The mines are numerous, and in general they are easily worked and free from water. The ore consists principally of limonite, which varies in its state of aggregations from a yellow pulverulent mass to a compact brown iron stone. It is mammillary, botryoidal, spongiform, and with stalactical forms, some of which have hemispherical and others acicular terminations, others are like bunches of pendant moss. The solid stalactical forms are fibrous, with diverging radii from the centre. The specimens are beautiful, and highly ornamental as curiosities and as minerals. The mines yield an aggregate of about 20,000 tons of ore per annum, which is worth at the bed $1.50 to $2.50 per ton. There are ten furnaces, it is said, within twelve miles of Amenia, which make, in the aggregate, about 10,000 tons of iron per annum. They afford employment to about one thousand men as ore diggers, coal men, teamsters, smelters, limestone diggers, &c. Some of these furnaces are in Connecticut, near the line, and it is about as well for New-York as if they were within her own limits. All the iron is carried to the Hudson river, and then shipped to various parts. There are two furnaces in Columbia and Dutchess counties not included in the above number, viz. Ancram and Hopewell furnaces. It is estimated that the aggregate annual value of the pig iron made at these twelve furnaces, is $400,000 to $500,000 per annum. Manufactories of malleable iron in various forms, are attached to some of these furnaces, as the Columbia furnace in Kent, the Ancram furnace, and some others. The malleable iron from these furnaces is highly valued for its toughness and softness, and is extensively employed in making anchors, musket and pistol barrels, wire, &c.

The geological situation of the ore beds is very constant. Most of the beds that I have examined are at the junction of mica or talcose slate with the gray and white limestones. The limestone generally crops out on the west side of the ore beds, and the mica or talc slate on the east, and both dip at an angle from 20° to 60° to the east-south-east.*

The ore bed at Fishkill was described by Dr. Beck in the report oı last year. Most of the galleries have caved in, in consequence of the injudicious method of working the ore. The superincumbent materials are clay, loam, gravel and pebbles, imperfectly aggregated like "hard-pan," so that when the soil becomes very wet they have little tenacity, and as the galleries are made large, and without any support to sustain the superincumbent materials, they cave in and render the extraction of ore, at present, expensive. The ore is of good quality, but more mixed with earthy matter than at many of the other mines.

The Clove and Dover beds were visited by Mr. Merrick. Messrs. Quaig and Rees have the contract for digging the ore at the Clove bed, where from 5,000 to 6,000 tons are dug annually. The ore is smelted in the Beekman, Dover and Bull's Bridge furnaces. The ore is delivered at the mine at $1.69 per ton, of which $0.94 is paid to the mine proprietors, and $0.75 per ton to the miners. This ore is a very pure hydrated pexoxide of iron, and is mostly fibrous hematite. This bed is bounded on the east by limestone.

Prescott's ore bed is one and a half miles north of the Columbia turnpike, in Hillsdale. It is bounded on the west by limestone, like those of Amenia, Indian pond, Fishkill, &c. This locality was discovered many years ago, and 40 tons of ore picked out of the bed of the brook and reduced in a forge. It was not much worked until 1822, when Mr. C. Prescott began the manufacture of yellow ochre at this place. The ore is hematite, in detached nodules, alternating with ochre and fragments of decomposed slate rock. The hematite increases and the ochre diminishes in quantity as you descend. The ore has been penetrated, according to Mr. P.'s statement, 32 feet, without finding bottom. This ore yields 33 per cent of bar iron when worked in the forge, and at least 50 per cent of pig iron, when smelted in the high furnace.

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* The association of these rocks is not only an interesting geological fact, but it shows an adaptation of means to ends. The limestone is convenient for use as a flux, and the talc and mica slate for firestone to line the furnaces.

Another ore bed is located three-quarters of a mile south of the above, also on the east side of the limestone, which was opened by Mr. Prescott in 1822, and which he has since sold to a Furnace company in Salisbury, Connecticut.

Mr. Prescott has made from his ore bed 275 tons of yellow ochre, which has been sent to market and sold.

The Amenia and Salisbury ore beds are the most extensively wrought of any iron mines, of this kind, of ore in the United States, and the iron from these beds is considered superior in softness and toughness to that of any other mines in the country.

The Amenia ore bed yields 5,000 tons of ore per annum, which gives on an average 50 per cent of pig iron. The mine is worked to the day like an open quarry. A layer of earth and gravel, and broken rocks, covers the ore from five to twenty feet in thickness. This is first removed, and the ore then excavated. They have not yet found the bottom of the ore in any place, although in one pit they have excavated into it 45 feet. It improves in quality the farther they descend. No estimate can be formed of the amount of ore in this bed, which probably unites with the others north and south of it. Estimating its breadth at 100 yards, and its length at 1,000 yards, with 15 yards depth, through which it is open, it is capable of yielding 1,500,000 tons of ore, and at the present rate of working will last 300 years.

Talcose slate crops out a few rods east, and white limestone a few rods west of the ore bed. Mines which have been and still are extensively wrought, have been opened over a distance of more than half a mile in length; the extent of the bed in these directions is not known. Another mine, possibly a continuation of the same bed, has been opened at Squabble Hole, about two miles S. S. W. of Ameniaville. The ore at this place lies under a deposit of pebbles, gravel, and loam, about 15 to 20 feet deep. It is supposed to be abundant. Many tons have been taken out during the past season. This ore was discovered in digging a well.

The Chalk pond ore bed was wrought extensively many years ago. It was abandoned in consequence of the water of the pond incommoding the miners. The pond has now been drained and the mine can be worked to advantage. The ore appears well, and will undoubtedly make a good iron. This ore bed is about two and a half miles N. E. of Ameniaville. The Indian Pond ore bed lies in the edge of Connecticut, between Salisbury and Sharon, and about six miles N. E. of Amenia. This bed has been described by Prof. Shepard.* It furnishes about 2,000 tons of ore per annum. The limestone forms its west, and the micaceous slate its east boundary.

The Salisbury beds are five or six miles farther north. They are extensively wrought, (about 5,000 tons per annum.) They also have been described by Prof. Shepard.†

Copake ore bed, two miles N. E. of Copake Flats, is worked, but not extensively. It yields about 1,500 tons per annum.

The limestone crops out a little west of the bed, and mica slate also not far on the east. The ore is probably abundant at a greater depth, but the mine may become a wet one if it be dug much deeper. An ore bed has also been opened two or three miles south of the above, and a mile or two north of Boston Corners, in Massachusetts.

The localities which have been described, are openings made in a few places, in extensive deposits of ore, and small quantities comparatively have been taken from them, while they are capable of yielding millions of tons to the enterprise of our citizens. The beds are undoubtedly continuous for great distances, and are a part of the great chain of iron deposits which extend from Canada to the Carolinas.

Although on the east side of the Hudson River, we have not *mountains* of iron ore, in the first district, we have beds which are inexhaustible, and so widely distributed, as to afford facilities of water power, fuel, &c. for a greater number of furnaces, than could be accommodated around one unwieldy deposit.

About 2,000 specimens have been collected for the State, during the past season, to illustrate the Geology of Queens, Kings, Richmond, Dutchess and Columbia counties. These, together with those of Suffolk county, are arranged in cases in the Geological Rooms of the first and second districts, above the State Library, in the Capitol.

There are eight suites, labelled and arranged, one of which is displayed in glass cases. The seven duplicate suites are arranged in seven layers of drawers, and are similar to that exposed to view.

W. W. MATHER, *State Geologist.*

Albany, Dec. 14th, 1837.

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* Shepard's Min. and Geological Report of Connecticut. † Idem.

REPORT

Of E. Emmons, Geologist of the 2d Geological District of the State of New-York.

To His Excellency William L. Marcy,

Governor of the State of New-York.

Sir:—

In accordance with the design of the projectors of the geological survey now in progress, I have continued my explorations in the district assigned me during the past season.

I commenced my labors in the field early in May, in the county of St. Lawrence, where they were pursued till the first of August. I then passed over into Essex county, where I spent the remainder of the summer and autumn. The geology of these counties was taken up in detail, with the intention and expectation of completing the survey of them the past season, but I was not able to accomplish it to my own satisfaction, and shall be obliged to visit several of the towns in each county at some future time. The progress of the survey is necessarily slow in wooded and uncultivated districts, especially where there is so much territory inaccessible except on foot, and besides this cause of delay, the consideration that mineral wealth is to be expected in rough and mountainous districts, is a sufficient reason for examining them patiently. There are too, in these counties, many known deposits of mineral matter, which require an attentive examination. Some of them may have been considered valuable, but may not be so from some cause or fault before overlooked; and again, those which have not been considered valuable may be so from the fact that the difficulties attending them may be obviated by some feasible process. It is well known that in beds of iron there are intermixtures of foreign minerals, which diminish very materially the value of the deposit, unless there is some mode of removing or neutralizing those intermixtures at a small expense.

In general the remedy for most of these difficulties is to be sought at or near the localities themselves. It is for this reason that known localities of the valuable minerals require very frequently an attentive examination. Other reasons than those mentioned might be stated, but these are sufficient to show that time and money is not necessarily wasted by a re-examination of the labors and discoveries of others. In Essex county I made a few observations on the topography of its western border. They are, however, to be considered only as the commencement of a series, which must be continued at a future time, and which are now too incomplete to be inserted in this report. In conjunction with Prof. Hopkins, I have made observations on the magnetic variation in this county, some of which will be found in the subsequent part of this report. The opinion expressed last year in relation to the elevation of the country of the upper Hudson, has been verified this season by measurement. It is, therefore, proved beyond a doubt, that the most elevated portion of the State is at the north, a fact which might have been inferred from the rise and direction of the great water courses of the State.

In St. Lawrence county the only exploration of consequence into the uninhabited sections, was up the Oswegatchie, which was extended as far as Cranberry lake. The results of this tour were not so important as I had anticipated they would be. I was unfortunate as to the weather, it having rained the whole time I was out, almost incessantly. This forms no trifling obstacle to exploring parties, especially when the time is limited to a few days. I was able, however, in this tour, to determine the rock formations, and particularly the extent westward of that peculiar granite which bears the iron in Essex.

The above is a summary account of the explorations of the past season. I shall now give more in detail the facts and observations which have fallen under my notice; more particularly those of practical importance, though I do not judge it expedient to exclude those facts which have reference to science, as has been proposed in former communications relating to the survey.

The county of St. Lawrence is 2,717 miles square. It is larger by 1,000 square miles than any other county in the State. Its shape is triangular, having the longest leg of the triangle along the St. Lawrence river, which is supposed to be about sixty-five miles in length. There are two tier of townships lying parallel to the river, which were intended to be ten miles square. The first is beautifully level; the second begins to be somewhat hilly. The townships in rear of these are decidedly hilly, but not mountainous, excepting those on the extreme eastern border, at the sources of the principal rivers of the county. The slope of the county is not in a line perpendicular to the course of the river, but nearly parallel to it, intersecting it, however, near the north-western angle, and near the junction of the De Grasse, Racket and St. Regis rivers with the St. Lawrence.

The soil of the first and second tier of towns along the St. Lawrence, may be set down as good, to which may be added large portions of the third tier. We may, therefore, consider two-thirds of the whole county as arable and productive land, or about 1,800 square miles as of this character.

I have bestowed some attention on the nature and natural fertility of the soil in the several towns I visited. The number of specimens of the soil I collected is not numerous, but they will represent the kinds and classes which prevail in the county, so that an examination of them chemically will determine one or two important questions, viz. what the elements of the soil are, and what is probably wanting in them to make them the most productive, considered independently of their local connexions.

Previous to entering upon the subject of the soils of this county, I shall state some facts and principles in relation to them in general, which are established by experience and observation. In the first place, in relation to productiveness, it may be said, that a soil is productive in proportion to its right adjustment to the four following circumstances: 1st. Its texture and cohesion. 2d. Its composition. 3d. Its substratum. And 4th. Its elevation. All of which is to be considered independent of the quantity of animal and vegetable substances they contain.

1st. The texture of the soil must be loose to permit the free penetration of roots and the access of air and water. When its texture is so close that the air is excluded, and the fibres of the roots prevented from penetrating downward, the soil must be unproductive of the valuable vegetables.

2d. There are certain elements which enter into the composition of soil, the presence of which are necessary to ensure its value to the husbandman. These elements are the following earths: silex, alumine and lime. The great predominence of the first makes a soil too open and loose; of the two last, too close and tight. Besides these mechanical effects they are each of them necessary in the economy of vegetables.

In confirmation of this statement, I will quote the analysis of the ashes of several vegetables.

	Silica.	*Lime.*	*Alumine.*
Wheat,	48	37	15
Oats,	68	26	6
Barley,	69	16	15
Rye,	63	21	16
Potatoes,	4	66	30
Red clover,	37	33	30

In addition to this I will quote farther the analysis of some of the most productive soils, which will serve as standards of comparison in estimating the value of any soil for agricultural purposes. The first was a good wheat soil, and contained, in one hundred parts,

Coarse silex,	30
Silica,	26
Alumina,	14
Carb. lime,	30

Another fertile soil furnished

Silica,	77 to 79
Alumina,	9 to 14
Carb. lime,	5 to 12

The most fertile soil formed artificially by the mixture of different earths, yield, on analysis,

Coarse silex,	25
Silica,	21
Alumina,	16
Carb. lime,	37

Nothing of course is said of the quantity of water, or of vegetable and animal matter present in the soil, as the inquiry related solely to the earths essential to fertility. From these analyses it appears, that those earths enter directly into the vegetable economy, and are therefore essential to the perfection of vegetable products.

It does not appear from these or any experiments which have been made, that a soil must consist of certain elements in a definite or certain given proportion, so far as they are necessary in the economy of vegetables, but only that they should exist in a sufficient proportion to supply the wants of vegetation. It is evident that where lime is in a small proportion it would be removed in the course of years entirely, to supply the wants of the vegetable kingdom, as it enters directly into the vascular system.

3d. The substratum influences greatly, the productiveness of soil. If it is a tenaceous clay, it will be too wet and cold. The natural productions of such soils, are coarse grasses, such as the caries and cyperoideæ, which are of but little value to cattle; and woody plants, whose stems are small, as the alders and birches, all of which are useless for fuel. This is a defect, which cannot, of course, be obviated by manuring. Such a soil retains with tenacity, a certain quantity of water, generally to saturation, and at the same time suffers the falling showers to pass over it without penetrating to much depth, or holds it in the soil above, if the outward drainage is insufficient, forming under these circumstances a condition unfit for tillage. The evaporation from the surface of marshy districts, preserves the temperature in a low state; a state to which some vegetables are fitted constitutionally, but to which others, the more useful, can never adapt themselves.

4th. Elevation. The diminished effect of the sun's rays, together with the exposure to winds in elevated districts, prevents the development of vegetable forms, and at certain points vegetation ceases from want of heat. The most useful vegetables cease to flourish, and come maturity far below the line of perpetual frost. In this latitude, corn and some other vegetables will not come to maturity at 1,500 feet above tide. The influence of latitude is the same as elevation.

There are three other points on which I will dwell for a moment. The first is, *how* a soil naturally good may deteriorate; and the second, *how* it is to be restored; and third, *how* a soil defective in certain points is to be treated.

1st. A soil may deteriorate by the consumption of one or more alkaline earths it contains, as lime or magnesia. This is more likely to occur on lands from which the crops are removed, and which are in a high state of cultivation. This may be especially true, where the crop has been of wheat or potatoes for a succession of years.

2d. Constant cultivation has a tendency to reduce the soil to an impalpable state, or it will become in time, without the application of proper correctives, too compact.

3d. Cultivated lands, or those under the plough especially, are exposed to washing, by which that portion of the soil in a state fit for absorption into the vegetable structure, is carried off and removed to levels more or less remote.

On the second point, *how* a soil is to be restored to its original state, when exhausted by cultivation, it is self-evident, that the element or elements, which are wanting, are to be restored artificially. Of the manner how we may ascertain what is wanting, independent of analysis, it is sufficient to remark, that, so far as the food of plants is considered, there is in most soils, and probably always will be, a sufficiency of silex and alumine; and as the alkaline salts exist, in the smallest proportion, it is probable, that when a farmer finds his crops gradually diminishing in quantity, notwithstanding the use of stimulating manures,* the defect is owing to the exhaustion of the alkaline earths; and these are the elements which must be supplied either in the form of gypsum, carbonate of lime, or of quick lime.

3d. In the last place, how a soil, naturally defective in any of its elements, is to be treated, may be answered as above, viz, by an artificial supply of the deficient earths. If it is argillaceous to an excessive amount, sand must be used; if sand is in excess, clay or loam. Experience has proved that no soil can be productive by the use of manures, neither can it be preserved to an indefinite period from wasting its strength by them alone.

It is proper to remark here, that the system of husbandry for this country, must differ in some respects from that pursued in England, and the highly cultivated parts of Europe. Limited as they are on the other side of the waters, and restricted within narrow bounds, they can and must expend their resources on small sections of land. There, a few acres of soil must receive the whole attention of the cultivator. But here, with a rich and fertile continent, nearly unbroken by the plough, there are but few temptations to expend in the annual cultivation of some twenty or thirty acres, sufficient to purchase a farm in the new and rich lands of the west.

It is difficult, therefore, to propose or introduce a system of husbandry, which would be approved here, even if it is in the most successful operation abroad. There is no question in relation to the *improvement* of the lands which have long been under cultivation, and which have, as it is termed, run down, and at an expense, too, in the reach of every land-holder; still, the systems of improvement must be adapted to the state and circumstances of the country. It must not be too expensive. It is necessary to learn the cause of the failure of lands, whether it is the want of vegetable and animal matter, or whether the essential elements of the soil are wanting. The remedy of the latter defect is generally close at hand; sands, clays and marls are usually in proximity, and they are naturally the correctives of each others defects.

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* It would seem, from the following statement, that the value of carbonaceous matter, in promoting productiveness, is not sufficiently known. It was furnished me by a gentleman of West Port, in Essex county, and may be relied upon as correct. 210 feet of land, on which a coal pit had been burnt, produced one bushel and 26 quarts of wheat; each kernel produced from 15 to 20 heads, and each head from 60 to 100 kernels.

In resuming the subject of the soils of St. Lawrence, I remark, that a soil is to be considered as formed or made up of rocks, broken down to different states of fineness, in part by the action of streams and currents, and in part by frosts and atmospheric agents. The soil formed of each stratum of rock, possesses a certain character, depending, in this respect, on the mineral character of the stratum itself. Owing, however, to the manner in which detritus, or the matter abraded from rocks, is carried down to the lower levels, there is necessarily an intermixture of materials from different rocks, so that a soil formed purely from a single stratum, is never found except in very limited districts; a result very important and fortunate to the interests of agriculture, as the productiveness of soils is greatly promoted by such intermixtures. The parent rock of the soil of St. Lawrence, is evidently gneiss, as out of seventeen specimens of soil collected in different parts of the county, more than half contain small pieces of this rock.

The character of a soil formed from primitive rocks, is always siliceous, notwithstanding there are alternations of calcareous, and to some extent, argillaceous rocks. This is owing, not wholly to the predominance of silex in the former rocks, but partly to the softness of the latter, which are reduced to a state of greater fineness, and consequently are transported farther from the primitive formations, and perhaps do not find a resting place until deposited at the bottom of the ocean.

The soil of St. Lawrence might, with propriety, be divided into two classes, sandy and clayey; the mixture of these two frequently occur. Clay may be found beneath the sand at a greater or less depth. It is, therefore, the basis on which the soil properly reposes. It exerts an important modifying influence on the character of the materials it supports. From what has been said on the preceding page, it is evident that it is not sufficient to say simply, that a soil is sandy or clayey, or a mixture of these materials; there are other questions of importance to be answered, viz: whether the clay is marly, or clay mixed with carbonate of lime, or if siliceous, whether it contains any quantity of lime or alumine, or is exclusively composed of siliceous grains; for, as it has already been remarked, that the natural goodness of the soil depends on the proper admixture of silex, lime and alumine; and farther, it is essential that the degree of fineness in the particles should be noticed, for a soil which is composed of $\frac{19}{20}$ths of impalpable matter, is wholly barren, whatever elements enter into its composition. The mechanical texture is, therefore, a question of importance, and ought not be passed over unnoticed in their examination.

The questions for consideration now are, what are the essential elements, or chemical composition of the lands and clays of St. Lawrence? In answer to these questions, it is proper to state, that no attempt has been made to ascertain the precise proportion in which the earths are combined, but merely the fact of their presence.

In the first place, as it regards the sands, more particularly those which are of the purest kinds, and the least intermixed with clay, so far as external characters are concerned, I find that the fine siliceous matter amounts to about 80 per cent. A specimen of soil taken from the banks of the Oswegatchie, between De Kalb village and Heuvelton, yielded water, 5; vegetable and animal matter, 3; alumine, 6; silex, 83; lime, 4. The siliceous particles are in a fine state.

Another specimen taken from the sandy plains east of Ogdensburgh, yielded the same, or nearly the same, results. The natural produce in both cases is the poorer kinds of herbage. Coarse grasses, willows, poplars, polypods, &c. Another example taken one mile west of Heuvelton, I found contained 20 per cent of alumine. An excellent growth of wheat was supported on the field from which it was taken. In general, the sandy soils are composed of $\frac{5}{6}$ths of siliceous matter, with but a small proportion of lime, not amounting to more than 10 per cent, and probably rarely over five. The clays upon the banks of the larger rivers, and especially the St. Lawrence, contain from 15 to 30 per cent of lime, forming that variety of clay called *marly*. This is an important fact, for, in the improvement of the sandy soils, much dependence may be placed on it for giving a proper stiffness to the lands, and also to furnish them the necessary quantity of carbonate of lime. In selecting the clay or marl for this object, it is essential that that portion which is intermixed with the land, should be excluded; unless it contains marine shells, which is often the case on Lake Champlain, where the same formation occurs. There appears to be also more lime in general in the superior layers of the clay, than in the inferior. The presence of any of the carbonates may always be tested by effervescence on the application of vinegar, or any of the mineral acids, a fact which every farmer ought to know, in order to be able to make the most of the beds of clay on his farm. In fact, it is easy for any one, though not much practised in chemical manipulation, to ascertain nearly the quantity of lime in 100 parts of clay, simply by dissolving out the lime by warm vinegar or muriatic acid, which is better, and then weighing the remainder carefully, after a thorough drying.

From what has been said of the soil of this county, it is easy to anticipate the application of the facts in a general way. It is certain, too, that on the sandy lands, carbonate of lime is an element wanting to ensure their actual improvement; and when the clays beneath are combined with this element, that *that* is material to be employed; as, while it gives greater firmness, and confers retentiveness to the soil, at the same time, adds an earth essential to the vegetable economy. It is hardly necessary to say, that each of the two classes of soil, are the mutual correctives of faults possessed by the other, as the first, which is always too loose and open when unaccompanied by the other, so the other is too close and too impervious of itself, a due mixture of the two being essential in the cultivation of the useful vegetables; not that one uniform mixture is to be sought or desired, as it is well known that the cultivated vegetables flourish the best, some in soils in which clay predominates, others where sand is in excess. There is one fact which is rather remarkable in the soil generally of the northern counties; it is the thinness of the vegetable mould. In those places where it would be expected to have a thickness of eight or ten inches, it is not more than two or three. It is also singular, that peat is wanting in the low lands, as it would be inferred that the climate possesses the requisite temperature to ensure its formation and growth; but, judging from the examination of many swamps and places, natural for its production, I presume it does not occur in the county. I have not met with it in a single instance. These two facts, so far as they go, prove the comparative newness of most of the northern counties; that is, it is geologically speaking, only a short period since the lower portions of the country were elevated above the ocean. For, had it been covered with vegetation a great length of time, the vegetable mould would have been thicker; and peat bogs would have formed, as they have to a great extent, in the southern counties, and in many parts of New-England.* In the marshes and low grounds generally, we come immediately upon the clays and gravels, after removing an inch or two of vegetable mould, and these are the situations where vegetation is luxuriant, and would favor, to a great extent, the accumulation of vegetable matter. There are other facts which favor this view, which will be stated hereafter. The farther prosecution of the agricultural character of the county, must be deferred until more perfect analyses are made of the soils already collected, or until the collections for this object are complete. This may be facilitated much, if agriculturists could be induced to forward specimens of soil, collected and put up as directed in the circular of last spring.

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* Or the former peat bogs and layers of mould have been removed by moving currents of water.

Having stated some of the leading facts in relation to the nature of the soil of St. Lawrence, I pass now to the consideration of that part of the service which belongs to geology proper, or in other words, to the description of the rocks. The general formations to which they belong are three; primitive, transition and tertiary. The consideration of the last will be omitted in this report. Of the two former, it may be said, that they occupy about equal areas in the county. The first or primary, is the surface rock, of all the southeastern townships. The division line between the primary and transition passes through Hammond, Gouverneur, De Kalb, Canton, Potsdam, Parishville and Hopkinton. The townships bordering the river, together with portions of the adjacent, are transition. At Hammond Landing, the primary and transition may be seen in close proximity, and probably are in contact; from this point, the line of division, as just stated, stretches away in a zig-zag direction, to Hopkinton. Of the different members of the primary rocks, gneiss is the principal. Associated, and interlamenated with it, to some extent, is hornblende. Other rocks intertrude irregularly in the form of beds and veins, as serpentine, soapstone, rensselaerite, granite and primitive limestone.

The gneiss district extends eastward to the intersection of the old State road and the Oswegatchie, a point about ten miles below Cranberry lake. From this point of intersection, a line being drawn to Duane, in Franklin county, will mark the eastern limit of the gneiss district. To the eastward of this, lies an extensive formation, important as well as interesting, but will not be described until I take up the Geology of Essex; remarking here only, that it is a member of the granitic family, and will be described as the Hypersthene rock. It is the supporter of the great beds of magnetic iron ore in the county of Essex, and also those of Chaumont.

It will be perceived, that the lines of division which I have drawn as the boundaries of the great geological formation of the country, run nearly parallel with the St. Lawrence. The first, which passes through the above named townships, lies between the transition and primary, or between the transition sandstones and gneiss; the second lies between the gneiss and a member of the granitic family, an unstratified formation, and very properly denominated as above. The middle district is the hilly portion of the county. The third and most eastern is, the mountainous, and bears only a small proportion in extent to the other districts. It is proper to remark farther, in relation to the gneiss district, that it is not purely gneiss. Large beds of other rocks frequently occur, particularly of granite and limestone. It is, therefore, only the basis rock, or the predominant rock; and although there may be a great variation, taking the whole stratum together, of mineral character, and the frequent occurrence of granite, limestone, sienite, hornblende, steatite, serpentine, &c. still I consider it better to denominate the whole as gneiss, and to describe the other rocks as subordinate beds.

In relation to the gneiss, it is necessary to remark still farther, that its stratification is often obscure; its texture confusedly crystalline; its mica not very distinctly disposed in parallel layers; and besides frequently occurs in thick beds; in fine, as a whole it appears to be one remove from the fissile gneiss towards granite, and in truth it often passes into it.

The apparent confusion occasioned by the passing of one rock into another, or the blending of the materials of one rock with those of another, though it tends to baffle all attempts at classification, yet it throws light on the circumstances which attended their original formation, or on the changes they have subsequently undergone. The observation of phenomena of this kind, lead by approximation to the final establishment of correct views of the nature and action of the forces employed in their formation, and are, therefore, worthy the attentive examination of the practical geologist.

Granite.

As has been stated already, the granite of this district occurs in beds and veins, subordinate to gneiss. The former are sometimes extensive. It varies in texture from fine to coarse; is usually gray, and frequently contains large imbedded crystals of feldspar, smoky quartz and large plates of mica. It occurs in three modes. 1st. In large irregular beds or protruded masses. 2d. In the form of veins, branching irregularly into the adjacent rock. 3d. In overlying masses, analagous to overflowing lava currents or greenstone. Whenever it is interlaminated with gneiss or any other rock, there is usually some evidence that the position is accidental, and the mass above is connected with an unstratified mass beneath.

Some of the most important localities of granite are in Gouverneur, Edwards and Fowler. The largest bed extends from Halesborough to Little-York, in the township of Fowler, a distance of four miles. It occurs also in Hermon, near the Teale settlement, in Rossie and Richville. Much of the granite at Gouverneur contains albite. So far as any of the localities have fallen under my observation, none of them will furnish a good material for building. Its texture is usually too coarse to spilt well or to endure the weather. In many places, more or less carbonate of lime, or carbonate of lime and magnesia, is diffused through it, which converts it into a perishable rock. The same remarks are applicable to the gneiss, so that neither rock is valuable, except for the coarser works, such as the underpinning of barns and outhouses.

Primitive Limestone.

Among the subordinate rocks, *primitive limestone* is among the most interesting and important. Having examined it minutely in this county, in Canada, and in many places in New-England, I am disposed to entertain different views of its character and origin than those taught in geological systems. These will be stated in the proper place. The primitive limestones are always coarse and crystalline, frequently friable, and rapidly broken down by the action of frost and the weather. Colour, usually white, or clouded with blueish black. A handsome green variety, which becomes a beautiful blue by exposure to the weather, occurs in Keene, at Long Pond. Some of the more perfect varieties, and usually called calcareous spar or Iceland spar, are limpid, amethystine and straw coloured. Usually, the rock is coarse and opake or merely translucent in their particles. For use in the arts, or as a building material, this variety is too friable, and too subject to disintegration, to be esteemed; and besides, it abounds in minerals of different kinds, much harder than itself, some of which, on exposure to the air, decompose and leave an indelible stain, which destroys its beauty when polished. It, however, makes the best of lime when pure, and the friable varieties may be employed to advantage on land in place of gypsum. Occurring, as this rock does, in irregular intertruded masses, it is impossible to estimate its extent. The area it occupies in the county of St. Lawrence is considerable. It occurs in all the townships in the gneiss district, and in some of them in heavy thick beds, as in Gouverneur, Rossie, Hermon and De Kalb. The situation and relative extent of these beds will be indicated on the geological map of the county.

Having spoken very briefly of this rock, (and perhaps too much so) I shall pass to the consideration of two important questions in relation to it. The first is of its stratification; the second, of its origin, whether aqueous or igneous. On both these questions, all our authorities place it among the stratified rocks, and it is of all others considered as of an aqueous origin. As these two questions are matter of fact questions, and not theoretical, dependant wholly on observation for their establishment, their discussion is admissible in the annual geological reports. It is my intention, however, on these points, to confine myself to the statement of facts, and besides this, to state them in as few words as possible.

First is, have we any limestones which are unstratified? In St. Lawrence county, all those limestones which occur among the primary rocks, as gneiss and granite, present no continuous parallel planes, dividing the mass into subordinate layers, one above another, like the leaves of a book. This assertion I extend also to numerous beds of the same variety of limestones in the primitive districts of New-England, and to the primitive limestones of the Ganonoqui, in Upper Canada.

The question of stratification being one which cannot be illustrated directly by diagrams, or proved in any other way than by an appeal to examination of the rock itself, I shall rely on the facts I have to adduce for the proof and support of my position, under the question of its origin; throwing out in this place a single caution to the reader, not to confound the marbles of Vermont and Massachusetts, particularly those of Berkshire county, with what I have denominated the *primitive limestones;* for I maintain that there is a wide difference between those marbles and the beds of limestones occurring among gneiss, granite, and hornblende rocks. All our granular limestones have been placed under one head, and have frequently been denominated *saccharoidal limestone*, embracing in the term all limestones of the primary class. But we have in this country the saccharoidal limestones in the transition and primary rocks; but the fact that there is so great a resemblance mineralogically between them, and also their occurrence in proximity to each other, especially in Berkshire county, Massachusetts, that it is not a matter of surprise that the two should be confounded under one name.

I shall now proceed to the other question, viz. whether there are any limestones of an igneous origin?

In the first place, I have to state that, we have the same evidence that what I have denominated the primitive limestones had an igneous origin, as there is that granite had this origin. The following series of diagrams, illustrating the relative position of this among the primary rocks, I present in support of my position.

1

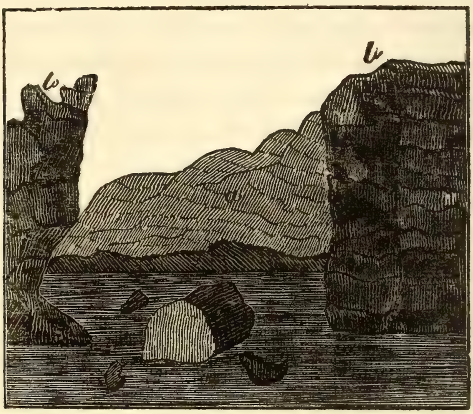


Fig. 1, represents a vein of limestone in granite, in Fowler, near the village of Halesborough. The limestone traverses a bed of granite in an easterly and westerly direction. It is about 20 feet wide, and crosses the Oswegatchie and spreads out on each side into wide beds, and connected only by this narrow neck or vein. At the place where the vein crosses the river it is much broken and deeply abraded; so much so that on the east side portions of the bed of granite beneath are exposed. If this instance stood alone, the position of the limestone might have been accounted for or explained on the supposition that the limestone was deposited from water above the granite, when it would of course fill all the cracks or inequalities in or on the surface of the granite. *a*, limestone, *b b*, granite.

2

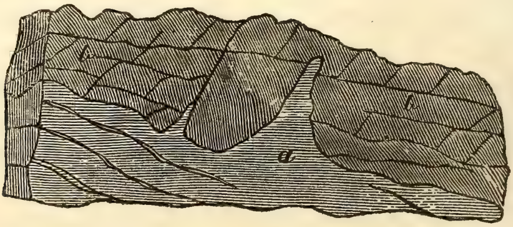
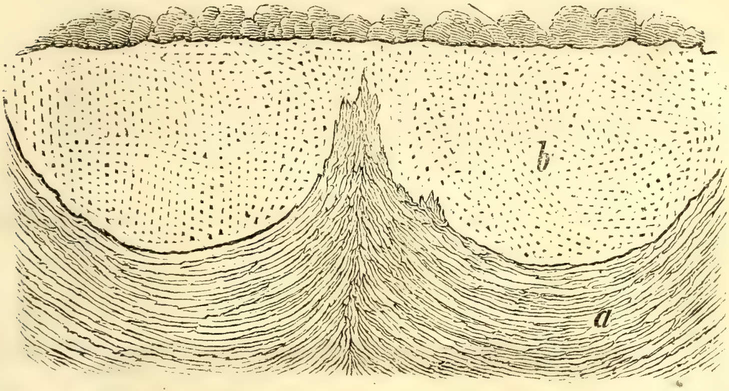


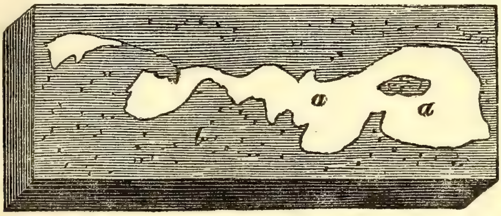
Fig. 2, is a view of the same rocks, taken a few rods above the preceding. *a*, limestone, *b*, granite. In this example the limestone is beneath the granite, into which it projects in the form of a triangular mass. The granite, in both of these cases, is sienite, and breaks into quadrangular blocks more or less regular.

3



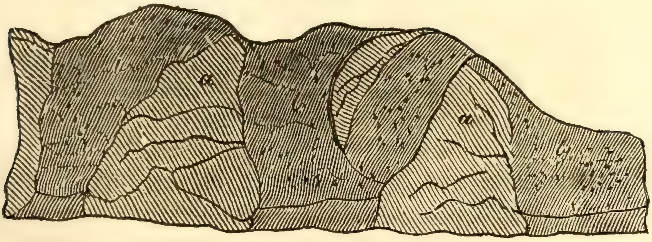
No. 3, is a view ot the connexion of a bed of limestone and granite in Lyndhurst, Upper Canada. *a*, limestone, *b*, granite. It will be perceived that this case is analogous to No. 2. The texture of the limestone and granite are both similar to the same rocks in Gouverneur.

4



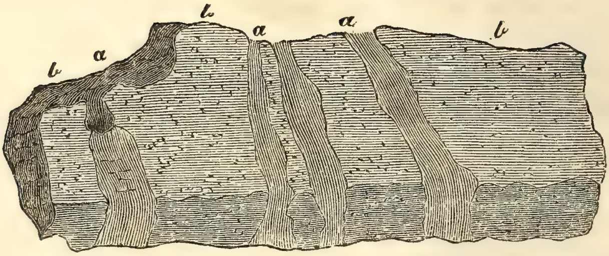
No. 4, exhibits an instance of the manner in which limestone branches into a granitic bed. It occurs near the preceding and in the same kind of granite. Cases of this kind are numerous. *a a*, limestone, *b*, granite.

5



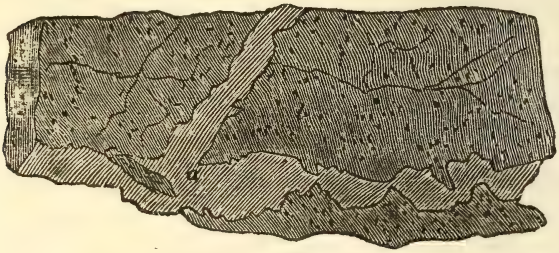
No. 5, exhibits another instance, or example, of veins of limestone projecting upwards through granite. They widen as they descend *a a*, limestone, *b b*, granite.

6



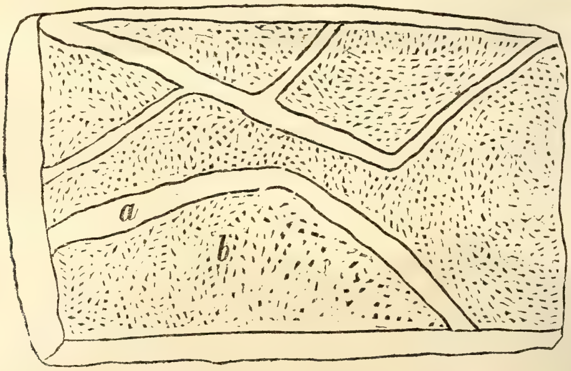
No. 6, exhibits 4 thinner veins of the same character as the preceding. *a a*, limestone, *b b*, granite.

7



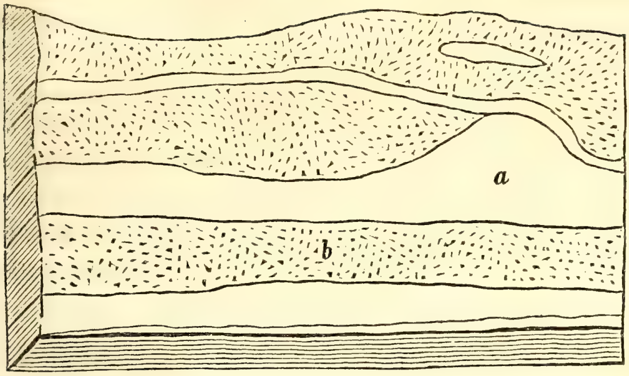
No. 7, shows the connexion of a vein which proceeds from another passing in a horizontal direction. *a*, limestone, *b*, granite.

8



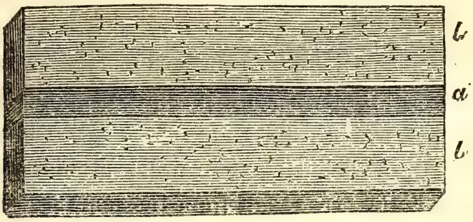
No. 8, is a ground plan of a series of veins connected with each other. The four last figures are taken from a field in Gouverneur, near the celebrated locality of Phos. Lime. *a*, limestone, *b*, granite.

9



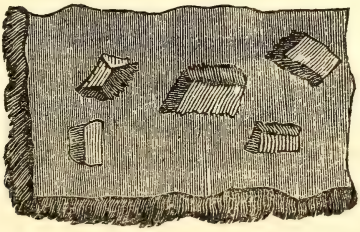
No. 9, exhibits an instance of veins of granite and limestone alternating with each other. It is a ground plan, and extends about 15 rods. *a*, limestone, *b*, granite.

10



No. 10, is a vein of limestone in granite, one foot in width; it may be traced along the surface 20 or 30 rods. It occurs near Mr. Tate's ore bed in Hermon.

11



No. 11, is a bed of limestone with angular masses of several primitive aggregates projecting from it. Instances of this kind are quite common.

It is proper to remark, that in all the preceding examples showing the connexion of limestone and granite, the two rocks are perfectly distinct and the line of junction between the adjacent portions well defined, as much so, as ever occur between a metaliferous vein and the rock embracing it. There are, however, many localities at which the limestone and granite are intimately incorporated, or irregularly mixed. They form together a rock subject to decomposition. Cavities of some considerable extent are frequently met with, which have been formed by disintegration and decomposition. They are often lined with crystals of calcareous spar, gypsum, and sulphate of baytes. Wherever limestone is incorporated or blended with granite in the manner here stated, the former is more or less charged with magnesia.

In relation to the primitive limestone, there is one fact which I deem worthy of notice, and which, it appears to me, has a bearing on the question under discussion. It is the presence of foliated plumbago in all the primitive limestones. At the first thought this fact may not appear in point; but when it is compared with a result which always occurs in furnaces, when in good action, it certainly becomes important. It is interesting to observe the abundance of foliated plumbago in the slags of furnaces and forges. This substance is made when the furnace attains its maximum heat, and when it is in perfect operation, but never when the heat is below a certain standard, or when it works indifferently. Now in both of the instances in which plumbago is found, may not its formation in both cases result from the same cause, viz: the action of heat, or in other words, as we know it to be produced by heat in the latter case, may we not infer that it is so in the former? Plumbago is insoluble in water, and never has been formed artificially in the humid way; yet we know it may be formed by heat, though a combustible substance. I do not wish to make more of the facts than they are worth, standing as they do, they seem to favor the view here taken of them, and when corroborated by other evidence, the position assumed cannot be easily shaken.

Again; I infer the igneous origin of the primitive limestones, from the effect which they have had on siliceous minerals with which they have come in contact; thus in Rossie, a vein of limestone in gneiss has rounded by partial fusion, apparently crystals of quartz upon its surface. Pieces of quartz, at the same place, in a massive state, have all the appearance of having been in a forge and partially melted. I do not confound in this case the slaggy appearance which results from a decomposition, with real igneous effects. Specimens illustrating the change I refer to, may be seen in the collection. The remarks I have made in the change produced in quartz might be extended to phosphate of lime, but as the effects are not so palpable, it is sufficient for my purpose to refer to them. Phosphate of lime is also produced, or found in lavas, particularly those in Spain.

Again; the sandstone, in contact with this variety of limestone, has been converted into well characterized hornstone; that is, a rock which is always composed and made up of granular particles, and is evidently of mechanical origin, is found, when in close proximity to this limestone, a perfect hornstone with all its translucency and toughness, conchoidal fracture, and sharp cutting edges. Such is the change, and if the adjacent rock was granite, no one would now hesitate to ascribe the change to the granite. A specimen of the hornstone is in the collection, and the locality from which it was taken is near the village of De Kalb. It is rare to meet with these rocks in contact; I do not remember to have seen another instance than the one here mentioned.

In concluding my remarks on the subject of the limestone of St. Lawrence, I remark, that if I have failed in establishing its want of stratification, and that it is like granite, of igneous origin, still I think it will be admitted that the views and considerations I have presented are at least plausible.

If the phenomena of granitic veins have obtained for this rock a rank, or place, among the igneous products of the globe, why may not the same phenomena obtain for limestone the same rank and place. If not, how shall we account for the presence of branching irregular veins. How were they produced! An inference which is legitimate in one instance must be so in another, where the facts are the same; and if geologists are right in maintaining the igneous origin of granite or greenstone, I do not see how they can refuse to admit limestome a member of the igneous family.

Additional remarks on the economical uses of the primitive limestones.

The economical uses to which the granular or primitive limestone may be applied are three. 1. When sufficiently free from the hard imbedded minerals and sulphurets, it forms a tolerable marble; but it is not equal to transition marbles, either in beauty, texture, or durability. The most promising localities for this material are between Rossie and Gouverneur, and on the farm of Judge Streeter, in the latter place. Its coarseness is a great injury to it as a building material, either in or out of doors, and it appears also to be more liable to discolorations by the oxides and sulphurets of the metals, and also to the attachment of lichens, or minute plants.

The most important purpose to which this variety of limestone can be applied is of course for quicklime. It is necessary, however, to select those masses which are free from imbedded minerals, as feldspar scapolite quartz, tourmaline, &c. as besides the insulated crystals there is always in their vicinity more or less silicious matter intimately combined with the lime, which after burning is incapable of being slaked, and is of course useless.

In the primitive district of this county, I have found in every township I visited sufficient limestone for all the economical uses to which it has been applied, with the exception, that for marble it is doubtful whether any occurs of the best quality; but this deficiency is supplied by another stone, which for building is superior to limestone.

The application of the unburnt or raw limestone to agricultural purposes, will be found advantageous whenever plaster is too expensive, especially the friable varieties, as those are always free from silicious matter, and are also pure carbonates of lime or lime and magnesia. The latter earth has been considered by agriculturists as injurious to land, but so far as observation and experience go in the country, the magnesian limestones are far from exerting an injurious effect, and it is doubtful whether they may not be used in the form of quicklime, at least in small quantities, without producing serious injury to vegetation. So far as improvements in agriculture are concerned, there is nothing of so much importance to the inhabitants of St. Lawrence county as the use of lime. Possessing the basis or foundation of the best of soils, it only wants, to bring them to perfection, the application and use of certain elements, easily and always attainable; and as it appears from the partial chemical examination of the soil that lime is one of the elements in which it is deficient, important beneficial results may be anticipated by the free use of this article alone.

That the views just expressed may be substantiated by decisive experiments, it is desirable that some enterprising farmer should procure a quantity of the primitive or white limestone in a ground state, and make application of it to various crops, particularly grass and corn. This would test two important questions—whether, in the first place, it does produce as good effects as has been asserted and partially established by experiment, and in the second place, whether it can be ground economically. In the use of it, there is no danger of applying an excessive quantity, as one third of the whole upper stratum of soil might consist of carbonate of lime without injury to vegetation. The best state for permanent use, is that of a course powder, or in the form or state of sand, in which there would be enough in a fine state for immediate effect, while the coarse particles would gradually pass into the state of dust, and thus supply vegetation with a never failing quantity of this element.

Among the valuable rocks of this county which may be employed in ornamental work, is *serpentine*. As it is but little used and known to the proprietors of land, it will be proper to describe it briefly. It is usually green, yellowish green, and sometimes reddish brown. Colours pale, and varying in intensity; the darker lying in a pale ground, imparts to the polished pieces an agreeable clouded appearance. Hardness, about the same as limestone; texture, always compact and close. In its pure state, or when unmixed with limestone, it does not effervesce with acids. It occurs in insulated beds in gneiss, mica and talcose slates. It is itself unstratified, which increases the labor and expense of raising it. Polishes easily and beautifully, which it retains as perfectly as marble, though the pale colours are liable, it is said, to fade. When made into mantle-pieces, it stands the fire better than the limestones, as it does not, like them, burn out, neither is it apt to crack by heating; besides, it grows harder by exposure to heat and air.

The largest and most valuable deposits are found in Gouverneur, Fowler, and Edwards. Generally, it is difficult to obtain large slabs of serpentine, on account of the checks and fractures pervading it; but at many of the localities in St. Lawrence the soundness of the rock is remarkable.

The only impediment to the introduction of this article for ornamental and useful purposes, is the expense of transportation.

It is to be considered as a treasure in prospect, as there can be no doubt it will be, as facilities for transportation are multiplied, and the artificial wants of community are increased.

Verd Antique.

At Pitcairn there in a fine locality of this beautiful marble. The colours are green and white, arranged in the usual forms of clouded marble. The serpentine has a bright green colour, and belongs to the variety usually called *precious*. The calcareous spar is white or grayish white, and forms a handsome ground for the translucent spepentine, The quality of the rock is excellent, free from natural flaws and fissures. So sound is it that a mass rings like a peice of clinkstone. This variety of marble has always been esteemed in works of art, and if I mistake not, bears in market a higher price than any other. Though this locality is distant from navigation, still it might be introduced into the parlors of the rich for ornamental tables, to the exclusion of foreign articles. To effect this, it is only requisite that it should be known, that the public may have an opportunity of judging of its qualities. Polished specimens may be seen in the collection.

Soapstone.

Allied to serpentine in mineral character, is soapstone, which is also one of the valuable natural productions of St. Lawrence. This substance is well known in the vicinity where it occurs; but its value is not fully appreciated. It may be cut, sawn, or turned, easily, and converted into a great variety of useful articles, at a very moderate expense; good beds of it are invaluable. It possesses a remarkable degree of toughness, and is also very refractory in the fire. When sawn into slabs and varnished, a great variety of soft beautiful colours are brought out, without any farther preparation. On exposure to heat it hardens, and then it is susceptible of receiving a high polish. It occurs abundantly in Fowler and Edwards. The white variety is the most valuable, on account of its forming with white sand, a white enamel, or an inferior variety of porcelain. Much of the so called soapstone is *Rensselaerite*, the grayish green coloured stone used for inkstands, is this mineral; its qualities are much the same as the common soapstone.

Specular Oxide of Iron.

The full account given of the ores of iron in the report of last year renders it unnecessary to dwell at much length upon them at the present time. A few remarks only are therefore offered. The specular oxide occurs in two states, differing as much from each other apparently as two distinct species of minerals. The one is a red earthy looking stone, the other occurs in brilliant polished crystals, or crystaline masses. In composition they are the same, except when the former is mixed with earthy impurities; in evidence they are so, it is sufficient to state that when they are reduced to powder, they have a blood red colour, and possess the same characters in general; and the crystallized variety passes by exposure into an earthy state entirely destitute of lustre. It is associated with gneiss in beds of great extent. It appears to be contemporaneous with the rock in which it is imbedded. There is frequently a gradual passage of the rock into the peroxide of iron, and it is common to meet with large masses of the rock in the midst of the ore. It is necessary, therefore, to select the ore for smelting with some care. Little attention has been observed, however, in this particular, for it is not uncommon to see at the furnaces quite a large proportion of the ore mixed with useless stone. It appears probable that this ore contains titanium, as I discovered in the hearth stones of a furnace this mineral in a metallic state. A single stone, on being broken, furnished 20 or 30 specimens. It occurs incrusting the surfaces of narrow fissures, or cracks in the old furnace hearths. It resembles in colour native copper, for which it might be easily mistaken.

The difficulties which have been experienced in smelting the specular oxides, particularly the hard crystallized varieties, are rather unaccountable, for it appears, so far as analyses have been made of them, that they are free, in a great measure, from the sulphurets, and, also, the same species of ore has long been used in the Island of Elba. Their abundance in Fowler, Edwards, Gouverneur, and Rossie and Hermon, renders it an object of some importance to ascertain some method of working them profitably.

The following suggestions are offered on this point: 1. Let the ore be selected, taking the purer ore, and neglecting wholly that which is mixed with stone. 2. Let it be roasted, pulverized, and mixed in proper proportion with the pure carbonate of lime, or calc spar, and perhaps with a small quantity of clay. These steps are all that are necessary to prepare it for the furnace. The utility of the magnesian limestones for fluxes in furnaces is doubtful. The calcareous spar is employed for this purpose at the Bennington furnaces, and no difficulty occurs in the reduction of the ore, and the quality of the product is good. At any rate the substitution of the spar, which is a pure carbonate of lime, is worthy of trial, for I believe that most of the limestones which have been used as a flux for this ore, are the magnesian. The above remarks have reference more particularly to the process for obtaining soft iron from the hard crystalized variety.

There is something worthy of notice in the geological distribution of the ores of iron in the northern district of New-York, and the remark may be extended to all the great iron formations in the adjoining States. In St. Lawrence, the specular ores predominate, and seem to belong to this peculiar geological formation. In Essex county, the magnetic ores are the most common, and it appears too, that this species is characteristic of this formation. And again, in the western part of Essex, and eastern part of St. Lawrence, the rock contains another variety of magnetic iron, differing in some respects at least, from the common magnetic iron along the lake; and to mention another formation of iron, we have the brown hematites, situated among the limestones of Vermont, Massachusetts and Connecticut, and occupying the valleys of the green mountain range. Each geological formation furnishing an ore specifically different.

From these facts, and others which might be produced, it appears that ores of iron have been developed in all the great geological formations in this country, and in each it possesses some distinguishing peculiarities, so that when the same species is produced in two different formations, the circumstances under which they have been deposited have effected such changes in them that the process for reduction requires a meterial alteration. It is not intended, however, to assert that the characters of a species are so far changed that it can not be recognized as the same species, but that it has suffered a remarkable modification; and such is the fact in the magnetic ores, a part of which belong to the gneiss along the Champlain, and a part to the granitic or hypersthene rock of the highlands of Essex.

Bog Ore.

I visited a number of the deposits of this ore in the county, and found them all to have been produced from the decomposition of pyritous iron, and the oxides intermixed with it. This is the case certainly with some of the larger collections, as their formation could be traced directly to the parent rock, in which the sulphuret is largely disseminated, and which is also undergoing constant decomposition. Some small collections are found at the margins of springs, the waters of which are charged with the oxide and carbonates of iron, which on exposure to air at the surface, lose their carbonic acid, and form precipitates of the ore.— Deposits of this kind, may be seen at De Kalb village.

One of the largest collections of the former character, is in Hermon, on the lands of Dr. Thatcher, and Mr. Kent. The extent of those beds is not exactly known, but the quantity is inexhaustible.

One fault which all the ores derived from this source have, is, the intermixture of sulphuret of iron, which renders it necessary to expel the sulphur, by roasting, previous to subjecting them to the action of the furnace. Probably, however, exposure to the air a few months, in most cases, may be all that is necessary to prepare them for reduction. If this view of the subject is correct, a saving, in fuel, may be made, by raising the ore a year in advance of the time it is required for smelting, and exposing it, during that time in small heaps. During this period, the decomposition will go on, and the remainder of the sulphuret in the ore, will pass into the state of an oxide, in part, and the soluble parts containing sulphur, will be carried off in the rains to which they will be exposed. Besides this, the change in the state of aggregation of the masses, will be highly favorable to the reduction, by bringing them into an open and porous state.

It is believed that the exposure of all the ores of iron, in this manner, will produce changes in them, which will facilitate, more or less, their reduction, and, at the same time, improve the quality of the iron. I learn from the Hon. George Parish, the proprietor of the iron works at Rossie, that sufficient bog ore has been discovered in that neighborhood to improve greatly the quality of the manufactures of his furnace. The ore this gentleman employs is the specular ore, the earthy variety known in the vicinity under the name of the Caledonia ore. Two hundred tons of pig iron, manufactured from these ores, a mixture of the bog and specular, has been declared the best sent to the Boston market. The castings, also, at this furnace, are in the highest repute, as they possess the properties of smoothness or evenness of surface, and also endure a great heat without suffering an injury.

The daily average product at the furnace, in a six month's blast, was two tons. One ton of ore, yielding 1,130 lbs., but including the shot iron, is estimated as yielding 1,580 lbs.

It is probable that the state of the iron manufacture in St. Lawrence county, remains much as it was at the time of the publication of the report for last year.

The discovery of deposits of iron, during the last year, have been quite numerous, enough so to meet all the demands for the article, and furnish employment to thousands of individuals, and the consumption of all the wood which can be spared for this manufacture.

The relative location of the beds and veins of iron, cannot be well understood, without the aid of maps. The course and direction of those, which belong to the distinct geological formations, will be exhibited on the county maps when published.

Lead.

There are three localities of lead, which have been explored, to some extent, in this county—the Rossie, the Black Lake, and the Wilson vein. The explorations at the two first have been made, so far, that no doubt now remains of their value. At the latter, the prospects are, so far, favorable, that a shaft is about to be sunk, with prospects no way discouraging, as it regards, ultimate success, though it is not expected that the lead raised in the work will meet the expenses of it.

In the immediate neighborhood of the Rossie lead mine, as it is called, are four veins, which pursue as many different courses.

The first discovered, and first in importance, is the Nash vein. Its magnetic bearing is south, 80° east. The next is the Jepson vein, bearing south, 88° 30′ east. The Robinson vein bears about due east, and in the Ross vein, the bearing is not determined. These four veins intersect each other, at various points, and occurring in the immediate vicinity of each other, they form a very remarkable mining region. See map of the mining region of Rossie. Of this mineral formation, it will be sufficient to speak of the Nash vein to show the value and importance of the lead region of St. Lawrence, the mode of conducting operation, and the quantity of the metal already produced.

The rock in which these veins are found is gneiss, interlaminated with hornblende. The gangue is carbonate of lime, coarse, and crystaline, with druses of beautiful calcareous spar. The dip is nearly vertical, slightly inclining to the north, as may be seen by the diagram exhibiting a view of the eastern termination of the vein as it was when first exposed by the removal of the rubbish concealing it. See plate 1. The whole width of the gangue is four feet. The whole depth to which the mine has been worked, is 100 feet. At the depth of 40 feet, the average width of the vein of lead, is 2½ feet; at 80 feet, 3 feet; and at 100 feet, 3½ feet. Showing a gradual increase in width. It is to be understood, that there is not a width of solid galena of 3, or even 2 feet; but the width at which the lead appears in the vein of spar, is as stated at the various depths. It is every where more or less intermixed with the gangeu, even when it is the richest. It is considered, that a vein, 1 foot in width, having the usual proportion of lead, will pay a fair profit by working. The ore is reduced on the ground, or not far from the mines. The quantity of lead, manufactured since the first of January, 1837, amounts to 2,029,415 pounds. In conducting this process, it is found that dry pine answers a good purpose in smelting. It is a matter of some doubt whether it is as good as coal, especially coal of the hard woods. Still, there is economy in its employment under many circumstances.

Such are some of the statistics of the operations in lead at the Nash vein.

The Jepson vein, on Mr. Parish's new vein, towards the road leading from Rossie to the Oxbow, has turned out a large quantity of ore. At 40 feet from the surface, this is 2½ feet wide. The prospects are as flattering as at the old Rossie or Nash vein. The course and direction of the four veins, mentioned above, are laid down on a map on a large scale, constructed from actual survey, which see.

On the Black Lake, at Mineral Point, is another mineral region of some note. The principal vein, at 25 feet from the surface is 2½ feet average width. This resembles very much the Rossie vein, and has turned out some large crystals of lead, similar to those produced at the Nash vein.

The dip of the two last mentioned veins is to the north, and resemble in this respect, the Nash vein.

The Wilson vein, in the north part of Gouverneur has a vein of calcareous spar, of from 2 to 3 feet in width, in which there is disseminated small masses of galena, but not collected into a regular vein of lead.—It differs, in this respect, from the other veins. It is hoped that the perseverance of the proprietors of this mine will be rewarded finally with a good vein of lead.

As the operation of mining differs from almost any other business, and is presenting continual obstacles of a discouraging character, it seems necessary that Yankee enterprise should be conjoined with German perseverance, in order to be successful. The proprietors of mines, in this country, ought to be fully apprised that metallic formations vary much in prospect; at one time, there is a full vein of rich valuable matter, which soon dwindles to a thread, with just ore enough to serve as a lead, when again it will be found increasing, just at a time when all hands are ready to abandon the works.

From information I have received from the Hon. G. Parish, and Mr. Nash, of Ogdensburgh, and E. Dodge, Esq., of Gouverneur, since I visited the mining region in June last, a part of which is given above, it appears highly probable, that the hopes and expectations of the lead proprietors will be realized. It is true that many of the veins have been abandoned, and some have been disappointed in investments. They were made in a time of too great excitement, and with too little knowlege of the character of the veins. It may be considered as established, that a very narrow vein at the surface never will of itself pay for working, and that it is not probable that in following it directly downwards, it will enlarge into a wide and profitable deposit of lead. It may be what is called a leader, that is, conduct the miner along the surface to a wider vein. When facts of this kind are well understood, there will be no more danger of failure in the mining business, than in any other.

In the other veins of galena, which have been explored to the greatest extent, and which have yielded the most, there is a remarkable freedom from minerals of inferior value, or, the sulphuret of zinc and iron, especially the latter. This is a favorable circumstance, and accounts for the great softness of the Rossie lead. This increases its value, as it is more readily converted into white lead.

An examination of the country, in the vicinity of Rossie, must satisfy any one that it has the character of a mineral region, and that there is much probability that we have but just commenced in the mining business, and that there are many other deposits of lead to reward explorations.

Copper.

The opinion expressed last year, that copper would be added to the mineral wealth of St. Lawrence, has been in part realized. Two new veins have been discovered which have yielded quite a large supply of ore. One of these is about five miles from Rossie, beyond Baker's or De Long's mills. The other is in Canton, on uncultivated lands owned by Mr. Van Rensselaer.

The course, or direction and geographical position of the former, is given on the map of the mining district of Rossie. There is every indication here of a rich vein. I found that several tons had been raised from the mine in searching for a bed of iron.

The value of copper is so great that it is justifiable to risk a large sum in sinking a shaft to ascertain the nature of the vein.

The sulphuret of copper and iron furnishes, by chemical analysis. about 30 per cent of copper. But by intermixture of iron pyrites more or less in the vein, it is rare to obtain half that amount of copper by smelting in the large way. The following item of statistics may be interesting in relation to the Cornish mine.

In 1800, 53,981 tons of ore were raised, which yielded 5,187 tons of copper, equal to 9¼ per cent; its average price was £133 3s. 6d. In 1831, there was raised 144,401 tons, yielding 12,044 tons, equal to 8¼ per cent; average price £100 per ton. At the price of labor in England, there is no doubt but there was a large return of profit, even at this meagre yield of metal. It is now known, by trial, that a yield of 6 per cent will pay the cost of smelting. Now it is presumed that the copper of St. Lawrence will yield as much, at least on the average, as the Cornish mines; the addition, therefore, of 2 or 3 per cent over and above the cost and expenses of working will give a profit which ought to be satisfactory. Should the ore retain the richness it has near the surface, or the character of the ore continue the same as that which has been raised, both in Rossie and Canton, the probable yield, if the process is conducted skilfully, will be, I should judge, 12 per cent. This is, however, a matter of conjecture; it is said that copper veins increase in width downwards, if so, there is no danger of investments, when a certain quantity of ore may be relied upon. The geological relations of the sulphuret of copper are the same as those of lead. The veins have not the same regularity as the lead veins. The ore is more diffused through the rock, and the walls of vein are not so well defined. At Canton the ore occurs in thin beds, apparently between the layers of limestone, nearly in a horizontal direction.

The presence of copper in pyrites may generally be known by the rich yellow colour it gives it, or more surely by fusing a fragment with the blow-pipe, and using borax as a flux; a globule of pure copper will be obtained; or by roasting and dissolving in nitric acid, when a beautiful blue solution will be formed. The localities at which I have observed copper pyrites are quite numerous, but only a few of them appeared of such importance as to merit a particular examination. It is the case often, that a few handsome specimens may be obtained from a locality which, if our judgment was to be formed from them alone, would certainly be wrong, for it is not uncommon to find a few fine pieces at the surface in little beds or nests; these may disappear entirely, or be replaced by sulphuret of iron, which is useless.

Sulphurets of Zinc, Lead, Copper, and Iron.

In the town of Fowler a remarkable vein of the suphurets of zinc, lead and iron, in about equal proportions, occur on the farm of Mr. Belmont. The direction of the vein is N. N. E. and S. S. W. and the width about eight inches, but not well defined. These sulphurets traverse a bed of serpentine 40 to 50 feet wide. The occurrence of zinc intermixed with lead, is not favorable to the reduction of the latter.

In Pitcairn, galena occurs in serpentine, associated also with satin spar, and in Antwerp, galena and iron are found in connexion with serpentine. In these instances the quantity is small. There is not much probability that the Belmont mine will prove profitable. These are noticed more particularly on account of the serpentine which forms the gangue, a rock usually very lean in the metals, with the exception of the chromate of iron, and occasionally copper.

I have thus briefly noticed some of the deposits of the valuable minerals in the county of St. Lawrence. It will be seen that they all belong to the primitive formation, so called, and that they form an important addition to the wealth of this State. The short time which has elapsed since the first discovery of lead here, and the limited scale on which operations have been conducted, together with the pressure of the times; considering, I remark, what has been accomplished under these circumstances, it is a matter of congratulation that interests so essential to the manufacturers of this country are in a condition so favorable. Much credit is therefore due to the gentlemen who have conducted these operations, and persevered under discouragements until the whole matter is placed on a sure footing.

Sandstone of Potsdam.

Among the natural sources of wealth of St. Lawrence county, in which the public is interested, is the sandstone of Potsdam.

I shall not enter upon its geological relations, any farther than to state, that in Potsdam, and other towns, in which it appears, it uniformly rests on the primary strata; and in no part of the county is there any rock which interposes itself between it and the primary, so that it appears here, as the oldest representative of the transition series. The identification of this rock, with the sandstones along the southern border of Lake Ontario, will be a matter of some difficulty. It is geologically below the transition limestone, and never in the northern district alternates with it, but always holds the relation of an inferior rock. So much is known of its position, but still some doubt remains as to its general relation, and to its name and place in the series of rocks. Some call it the old red sandstone, others regard it as equivalent to the new, or saliferous rock of Eaton.

But our business is to describe the rock, as it is, and speak of its economical applications, leaving some doubtful points to be cleared up by future observations.

This rock is a true sandstone, of a red, yellowish red, gray, and grayish white colours. It is made up of grains of sand, and held together without a cement. Intermixed with the silicious grains are finer particles of yellowish feldspar, which do not essentially change the character of the sandstone, but they show the probable source from which the materials forming it were originally derived, viz. some of the varieties of granite. Unlike, however, most of the sandstones, it is destitute of scales of mica. The colouring matter of the rock is evidently oxide of iron, but unequally diffused through it, giving it intensity or deepness of colour in proportion to its quantity. In some places it is almost wanting, which makes it, when pulverized, a good material for glass.—The grains and particles in its composition are general angular, but where it takes the character of a conglomerate, as it does in the inferior layers, they are frequently rounded. The thicker strata exhibit an obscurely striped appearance, owing to prevalence of certain colours in the different layers.

Two properties possessed by this sandstone, increase, essentially, its value for all the purposes to which it can be applied, its durability, which is owing to its silicious character, its evenness of grain and strata, which facilitates and lessens the labor of quarrying, and afterwards saves the expense of dressing, preparatory to its employment as a building material. Both of these characters fits it admirably for every kind of use to which stone is ever required. As a fire stone, nothing can be found better, and if it is required for durable public works, as the locks of canals, &c., no material can be found better suited for the purpose.

The strata on the Racket river, where the principal quarries are opened, rise about 65 or 70 feet above the water. The quarries extend some 10 miles along this river, which has apparently cut through the rock, and exposed the strata on each side, dipping to the northwest, at an angle of about 30°. I have not ascertained the whole thickness of the beds.—The layers vary in thickness from ½ an inch to 4 feet, so that every variety may be obtained; and the thicker strata may be split to any requisite thinness for which they may be wanted. Slabs, having any superficial area, which can be used, and of the given thickness, may be quarried with ease. The waters from which this sedimentary rock were formed, must have been in a perfectly tranquil state, to have preserved such a regularity and evenness of surface, and freedom from contortion. Such a state did not prevail every where, even in the immediate vicinity of Potsdam, for at De Kalb, in the same formation, there are some very remarkable contortions and disturbances.

Sufficient has now been said of the qualities of this rock, to make known its true value and character as a building stone. The places at which it may be, or has been quarried, are numerous. In Gouverneur, is a fine deposit of it, in inexhaustible quantities on the lands of Dr. Murdock, also in De Kalb, in Hammond and Rossie, and on the Racket river, and in Potsdam, extending 8 or 10 miles, in the direction of Pierrepont. It occurs, also, in Hopkinton, and in Parishville. The color of the sandstone, at Gouverneur, which, for aught I can see, is as good as that of Potsdam, is gray. It is situated in the northwest part of the town, and dips to the northwest, at an angle varying from 5° to 10°. The thickness of this whole stratum of sandstone is no where great. In some places it is entirely worn through; in others, insulated fragments, or masses, remain attached to the primitive strata, and dipping into what were, at the time of the deposition of the rock, open fissures, or cracks, and every where showing that it is unconformable to the rocks on which it rests. The effects of currents of water on this stratum, are not among the least interesting geological phenomena of this region.

It appears that when the strata were elevated they were frequently fractured for miles in a north and south direction, and along the line of the greatest uplift they were in one sense comminuted, or broken into small pieces. Subsequently currents of water passing over the whole region, farther broke up and carried away all the loose materials. The result of the combined effects of the uplift and of the currents, have been the production of long narrow valleys, bounded on both sides by perpendicular walls of sandstone, which still stand, in many instances, like regular mason work. The fractures usually extend downward to the primary strata, and the whole stratum of sandstone has been sometimes removed down to the gneiss and granite.

That the above is not hypothetical, is evident from the rounded corners of those portions of the strata which lie along these valleys, and also from the scratches they received, and which still remain as perfect and fresh as if they were made but yesterday.

12

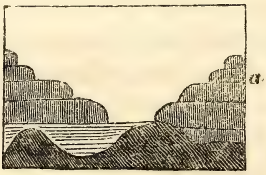


Fig. 12, is a transverse section of one of the valleys described above. The walls on either side are rounded and scratched; their depth varies from 10 to 100 feet.

The sandstone of Potsdam bears a land transportation of from 15 to 20 miles; and at these distances from the quarries it is considered as cheap a material for building as brick, and I venture to say there is no stone in the State, or any where else, equal to it for durability. As it regards beauty, individuals may differ, but there is no stone superior to it in this respect, unless it is marble. All the sandstones and freestones which are brought to the New-York and Albany markets, crumble more or less, and suffer eventually from the weather, but this will resist attacks of all the natural agents to which it may be exposed.

Buildings constructed of this stone have a neatness, comfort and warmth, which is not felt or perceived in dwellings made of other materials. This is my own impression.

As a *fire-stone*, the Potsdam sandstone is held in the highest repute. Composed as it is of siliceous grains, compacted together by compression, it is calculated to resist the highest degree of heat; and as it is uncrystallized, it is not liable to crack by this exposure. All the furnaces of St. Lawrence and Jefferson counties have their hearths of this sandstone.

Another use to which I conceive this stone may be applied, is for grinding hard bodies, and perhaps it may answer for coarse grindstones, and for some particular offices where a certain degree of hardness is required, it may be superior to the ordinary stones.

I have now given a general view of the agricultural character, and of the mineral riches of a part of the county of St. Lawrence. Much more might have been said on all the subjects which have been before me, and could I have extended my researches into the remaining townships, a much larger quantity of matter would have been accumulated. Some of the finest farming towns have not as yet been visited, and a large district of country along the Racket and De Grasse rivers, remains unexplored. I shall close my remarks on the geology of this county by reference to one or two subjects of general interest.

Comparison of the Geology of some portions of Upper Canada and St. Lawrence county.

The geological structure of the country on the east and west shores of the St. Lawrence river has a remarkable similarity. This similarity is not confined to the rocks, but extends also to the topographical features. As on the east, so on the west side also, the country is level and underlaid by sandstone, calciferous sand-rock and transition limestone. From Morristown on one side and Brockville on the other, the level region extends from 15 to 20 miles. At this distance the hilly region commences, lying along the junction of the sandstone and primary rocks. In Canada as well as in St. Lawrence, the country abouds in long narrow valleys and lakes.

The similarity of structure is not confined to the transition formation, or the valleys and lakes, but extends also to the primary strata, and the occurrence of similar minerals in the same geological ranges; thus veins of lead, copper and trap abound in both of the primary districts; also brown tourmaline in the primitive limestones, sulphuret of barytes, specular iron, albite, phosphate of lime, &c. In fine, a description of the rocks and minerals of the east side of the St. Lawrence would apply equally well to those of the west side, with the exception, that the dip of the strata are in opposite directions. This difference extends to the dip of the dykes and veins of lead and copper, those on the east dipping to the north, while those on the west side dip to the south.

For an illustration of the above remarks, see an east and west section on the map of the tertiary district of Essex county, Section I.

The surfaces of the sandstones and other rocks are worn and furrowed as in the county of St. Lawrence. The direction of these furrows near the head of Plumb valley are nearly north and south.

Facilities for obtaining Water, &c.

The level and less hilly portions of St. Lawrence county are underlaid by a stiff clay, above which are strata of sand and gravel. From these beds abundance of water may be obtained; it is always hard, but is not unpleasant for drink. The wells require to be sunk to the depth of only 15 or 20 feet. The following table exhibits the temperature of the wells and springs along the junction of the transition and primitive districts.

The temperature of two wells in Hermon.
1st. 52 feet deep, Temperature 45° Fah.
2d. 20 do do 43° do

Of two wells in De Kalb.
Temperature of the air 75° *July 20th,* 1837.
1st. Temperature 44° Fah.
2d. 18 feet deep, do 41° do

Of six springs in the village of De Kalb.

1st	45°	Fah.
2d	48°	do
3d	48°	do
4th, shaded,	46°	do
5th, open,	48°	do
6th	40°	do

The springs, the temperature of which I have given, all gush out in the valley in which the village of De Kalb is situated. They properly belong in the class usually called *mineral springs*. Abundance of tufa, oxide and carbonate of iron are deposited on the margin of some of the springs.

Temperature of air 75°, *July* 10*th*, 1837.

Temperature of two wells in Fowler.

1st, open and exposed,	50°	Fah.
2d do	45°	do

Of two wells,

1st	45°	do
2d, 15 feet deep,	44°	do

Temperature of a covered well 15 feet deep, in Gouverneur, 47°, air 75°, July 16.

Boulders.

Notwithstanding the abrasions which the county of St. Lawrence has suffered from currents of water, only a few boulders remain on the surface, which can be considered as having been transported from a distance.

A few belonging to the hypersthene rock, consistimg mostly of labradorite, are met with in Gouverneur and neighboring towns. The subject requires farther examination before I can speak of it with confidence.

GEOLOGY OF THE COUNTY OF ESSEX.

The surface of this county is decidedly mountainous, in which respect it bears a striking contrast to St. Lawrence. In addition to this, it may be remarked, that the hills, as well as the mountains, are steep and abrupt, and almost uniformly present, on one side, a precipice nearly perpendicular. In this county, there are no long and gradual slopes, or gentle risings towards the mountain summit, but they are always bold and difficult of ascent. A surface of country, thus characterized, combined also with great heighth, both of the general surface, and especially of numerous peaks, alters, to a very great extent, its agricultural character. By this combination, the mean temperature of the most elevated portions of the county is reduced so low, that the cultivation of some of the most useful vegetables is prevented, or they are crops so uncertain, on account of late springs and early frosts, that little inducement is held out of trying them even as a matter of experiment. There are, however, some bright and favored places where most of the essential vegetable productions are raised, and even grow luxuriantly, as along the shores of Lake Champlain, and the valleys of the upper Hudson. That a correct idea of the surface of this county may be conveyed to the reader, I have given several views illustrative of its scenery. From these may be gathered a more correct notion of its uneven and mountainous character, than from any description, however minute, especially the one exhibiting a group or view of the Adirondack mountains, on the extreme western border of the county. It may be proper to remark here, that these views were not introduced for the purpose of embellishment, or the exhibition of beautiful landscapes, but solely to convey to the reader what has just been expressed, a correct view of its surface, or of its general outline.

There are three distinct geological formations in Essex county.—1st. The primary, embracing granite and gneiss; 2d. the transition, and 3d. a tertiary formation, of the most recent period, belonging to the newer *pliocine*, of Lyell. I shall speak of them in the order they are named.

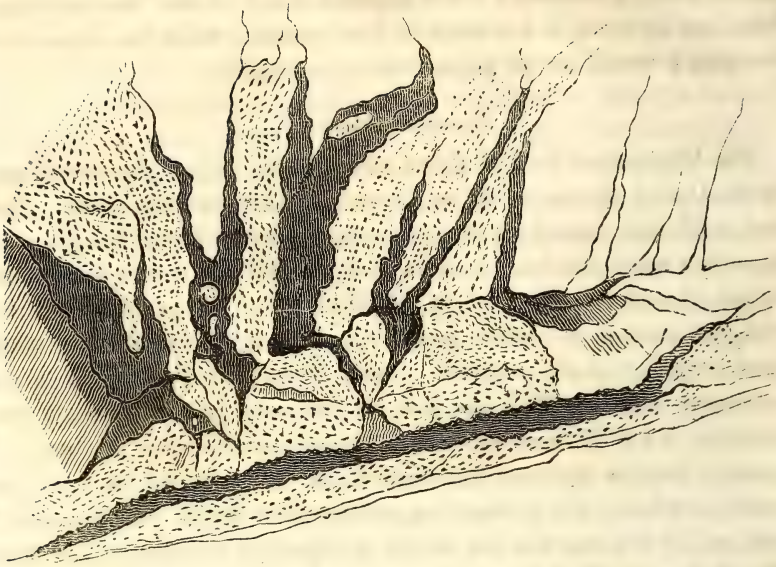
1st. Primary.—Two rocks only, of this class, require a particular consideration, viz. *granite and gneiss;* but as the latter presents nothing peculiar in its composition or relations, I shall merely speak of its extent, and mark, generally, its boundaries. The rock I term granite, demands something more than a passing notice. Correctly speaking, it is only a variety of granite, having essentially only two minerals in its composition, viz. Labradorite or *Labrador feldspar* and *Hypersthene.* That the character of the rock may be kept in mind, I shall denominate it Hypersthene rock, instead of granite, though it is not certain that it is identical with the Hypersthene rock of McCulloch, still no error will be conveyed when it is stated, that the feldspar of the rock is the Labradorite instead of the common feldspar. Hypersthene is as truly one of its constituents as mica or quartz in the common granite, though not so generally diffused, yet so much so, that in very few specimens of the size of a goose egg it may not be detected. Having a composition, therefore, different from the common granite, it is proper it should receive a distinct denomination, and as it is essentially composed of the two minerals already mentioned, so it may receive its name from the Hypersthene, as it expresses more significantly its true character. As I have placed this among the granites, it would be unnecessary to state that it is an unstratified rock, were it not that some geologists place gneiss among them also; calling it by way of distinction a *stratified granite.* Though it is a formation thus distinct, mineralogically considered, still it passes into gneiss, and other primary rocks which are adjacent to it It divides or separates into thick bedded masses, especially towards the summits of the higher mountains, where the decomposing agents are far more active than on the plains below. The true granites are acted upon in the same manner. The colour of the rock is a smoke gray, passing from light to dark. It is frequently traversed, by lighter coloured veins, on a darker ground, which are more distinctly brought out by polishing.—They have an injurious effect, as in those places where these veins appear no play of colours can be observed. When viewed at a distance, this rock resembles an hornblende rock. It has often a greenish or grayish purple colour, especially where it is exposed by slides. In a few places, it is wholly a greenish compact feldspar. At these localities the Hypersthene is wanting, and it loses its beautiful play of colors, so well known in the Labrador feldspar. No mica or quartz can be discovered in it, except as veins or small insulated beds, evidently having no more connection with the rock in the mass, than any other foreign mineral, that is, they do not form a part, or a constituent element of it. A more constant mineral is the magnetic, or protoxide of iron, small particles of which are quite common, and also small amorphous garnets, arranged in zigzag lines, surrounding the small masses of iron. The iron and garnet are, however, more common in the immediate neighborhood of the heavy beds of iron, and may be considered as indications of their presence. In the fresh, solid masses of the rock, or those recently broken from the quarry, the Hypersthene resembles so closely hornblende, that it may be mistaken for it; but after exposure to the weather, the lamina very slightly separate, and in this state the cleavages and primary form of the mineral are readily obtained. The Labradorite constitutes by far the largest portion of the rock. Taking the rock in a mass, the particles of composition are small, and irregularly mingled together, but never occurs in a compact state, unless in the greenish white variety, just spoken of. We frequently find, however, large blocks, or imperfect crystals of it embodied in the rock. These always exhibit more or less of the play of colours considered as characteristic of the species.—It is, however, generally coarse grained, as it would be termed, passing occasionally into fine. The colour of the Labradorite is a smoke gray, of different shades, in different specimens, generally opake, but often translucent, when the lamina are no more than ⅛ of an inch in thickness. In the most perfect specimens there are two reflections of colour, a blue and a green, the one appearing in one direction from the face of cleaveage, the other, from another. The bronzed, or copper coloured reflections, appear in pieces, which are weathered. It will not be useful to describe all the varieties of colour, which this single species presents. It is sufficient to say, that they are extremely numerous, and frequently of surpassing beauty. The polished pieces form gems highly esteemed in jewellery, which certainly have this recommendation, that they cannot be imitated, a fact which can scarcely be stated of any other gem. From these remarks, the general character of the rock may be gathered. I shall now speak of its extent. The first appearance of the Hypersthene rock, is in the north part of Schroon, on the State road. This is its southeastern limit. The eastern boundary extends from this point, north northeast through Moriah, passing about three miles east of West Moriah village, and onwards through West Port, Essex, Willsborough, and terminating at Port Kent. The northwest boundary lies along the Ausable, and may be traced to its source, and onwards in a southwesterly direction, to the west part of Newcomb. The Primary rocks, peculiar to St. Lawrence county, as gniess, hornblende and limestone, extend eastwardly as far as Newcomb. Gniess, accompanied by the same rocks, lie along the southeastern side of the Hypersthene rock, as in a part of Schroon, Crown Point, and the eastern part of Moriah. The breadth east and west of this Hypersthene formation cannot be less than thirty miles, and in length it extends diagonally across the whole county from Port Kent to Minerva. There is, probably, therefore, in the county of Essex, one af the most extensive primary formations in the whole State; and perhaps, there is no rock, or no single rock, in one continuous surface, so great as this in New-York.

The next inquiry, in relation to this rock is, has it any value as a building stone. In answer to this question, I have no hesitation in saying, that at many localities it will furnish the finest material for building, of all the family of granites. In the town of Jay, for example, there are some of the finest samples of this variety of granite I have ever seen. It is not, however, so much as an outside building material, I wish to call the attention of the public, it is as an ornamental article for tables, chimney pieces, &c., and for this service, I consider it best adapted and of the most value. Like other varieties of granite, it may be split into rectangular pieces of any size, and these may be sawn, as I have been informed, into slabs of the requisite thickness. When it is brought to this State, it receives a polish superior to any of the American marbles, and its worth is five times at least greater, while the expense of working it would not be proportionally as large.

Imbedded Minerals.

The Hypersthene rock of Essex, embraces the largest deposits of iron in the United States, so far as discoveries have yet been made. One bed, in Moriah, underlies a tract of land of between 30 and 40 acres, that is, with a spade, the bed of ore may be reached any where within that extent of surface. This is the Sandford bed. Its quality is not the best, but answers a tolerable purpose in the manufacture of iron, when great toughness is not required. Again, there is a narrow belt of ore extending from the Hall ore bed, in the north part of Moriah, into Schroon, in a S. S. west direction, a distance of 10 miles at least. I consider that the Hall and the Canfield ore beds, are but parts of one continuous bed. Or, if there are interruptions by the interposition of rock, still it is along this line we are to expect the discovery of ore beds. The Hall ore bed is 5 feet wide, and the Penfield, and another bed belonging to two enterprising gentlemen in Crown Point, are, in some places, 10 rods wide. The extent of the beds at McIntyre were mentioned in the report of last year. One solid body of ore on Lake Sandford, is probably 500 feet wide, and its extent north and south unknown. I consider, however, that the beds about McIntyre, are parts of a belt of an iron formation, which extends southwesterly through the wilderness to the town of Chamont in St. Lawrence county, and that along the line connecting those places, many beds remain to be discovered. No one of these beds of iron may be equal to those of Missouri, described by Mr. Featherstonhaugh, still, *put together*, there is a much greater quantity of it, and farther, more advantageously distributed, on account of a better supply of wood, than there possibly could be if all the beds constituted one or two mountains of ore. I have not discovered any other valuable mineral in the Hypersthene rock of Essex.— The junction of the iron ore with the rock, is not uniform. Sometimes the line of junction is distinct and straight, like the line of junction between a vein and the adjacent rock. Again, the iron branches into the rock, similar to veins of granite, of which fig. 13 is an example. Sometimes the ore is disseminated in the rock in small particles. I conceive, however, that the iron is contemporaneous with the rock, and never occurs in veins or deposits less ancient than the rock itself.

Fig. 13.



a, ore; *b*, rock.

Before closing my remarks on this species of ore, I desire to mention the fact, that it is reduced at a lower temperature in the forge than any ore I have met with. This is a matter of great consequence, when it is considered that in the interior of Essex the soft woods are the most abundant, and must be relied upon in the reduction of it. From trials which were made at McIntyre this last season, it was settled, conclusively, that the ore may be perfectly reduced with spruce coal alone, and that it possessed advantages over the coal of hard wood, independent of the facility of obtaining the former. In addition to this, I will add one more fact which may be of some interest to those who are engaged, or who may be hereafter engaged, in the manufacture of iron, in relation to the value of an ore, independent of its richness or location; I will therefore state, that the value of an ore depends on two conditions: 1st. its freedom from sulphuret of iron, and other injurious minerals, as the phosphates of lime, iron, &c., the effects of which are well known; and 2d. on the facility of reducing the ore to a powder. The latter condition is one which is very likely to be overlooked, as the inquiries usually embrace those only which relate to its richness, or the quantity of iron it will produce, and its quality; whereas, it is plain that if the ore cannot be broken up and reduced to powder, it will be quite difficult to work it, so that although it may be rich and free from injurious minerals, yet, when tough and unyielding to the hammer, the expense and trouble of bringing it into a suitable state of subdivision must form a serious obstacle to its reduction, and greatly increase the trouble and expense of its manufacture into iron. Some of the ore beds of Essex are in this condition, but it is a matter of little moment at present, since there are others free from this objection, and are capable of furnishing sufficient ore to meet all the wants of capitalists.

Limestone.

The limestone associated with the hypersthene rock, uniformly occurs in veins, is coarse granular, and is injured by the presence of numerous imbedded minerals, as the tabular spar, amphibole, pyroxine, idocrase, phosphate of lime, &c. The tabular spar is a mineral which resembles the coarse primitive limestone, and has actually been taken for it, blasted out, and put into a kiln and burnt, at an expense of some 50 or 60 dollars. The relation of the limestone to the rock embracing it is such as to confirm the views already expressed of its origin, in the geology of the county of St. Lawrence.

Phenomena of Dykes.

The most remarkable geological phenomena of this region, are furnished by the dykes which traverse the hypersthene rock. A view of one of these is given in plate IV. and a distant view of another in plate VIII. on the right.

The mineral character of the dykes may be reduced to four kinds:—1, a well characterized greenstone, with oval cavities, which have been filled with chlorite or carbonate of lime; 2, a compact amphibole, or hornblende; and 3, sienite, or a compound of feldspar and hornblende; 4, a reddish porphyry, in which the crystals of feldspar are small and indistinct. They pursue an easterly and westerly course, and extend a great distance; and, indeed, I have not been able to ascertain their extent in a single instance. This is owing partly to the wooded state of the country. The largest of them is at Avalanche lake. It is 80 feet wide, and cuts through Mount McMartin, nearly in its centre. The gorge formed by the breaking up of this dyke extends entirely or nearly to its summit. A portion of the northern face of the wall may be seen from lake Henderson, a distance of five or six miles. A view of this mountain is given in plate 7. This gorge exhibits, on a large scale, the powerful effects of frost and water, in breaking up the solid crust of the globe. In it are rocks from 50 to 100 feet in length, broken up from their original beds, and carried partly down the declivity; they lie in confusion in all directions, and constitute together a mass of ruins from the base of the mountain to its summit. On some of these detached masses, I found a scanty herbage just sufficient to form a foothold, or shrubs of the white birch and balsam, on which to hang for the moment, while clambering over the steep and slippery sides, while others were perfectly naked, having been but recently removed from their original beds. The rains, frosts, &c., are constantly working upon the whole of this immense mass of ruins, gradually pushing them to the valley below, where only they can find a resting place.

Gneiss.

The gneiss of this county occupies but a limited extent. It appears at West Port along the shore towards the high rocks. From Cedar Point it extends west towards West Moriah, five or six miles, where it meets the hypersthene rock, or rather passes into it. This is the western limit. It has a perfect resemblance to the gneiss of New-England, and is more distinctly stratified than that of St. Lawrence county.

It contains numerous beds of iron, both magnetic and hematitic. It is interlaminated apparently with saccharoidal limestone, sometimes intermixed with serpentine and other interesting minerals.

The dip of the strata at Bulwagga Bay and at Crown Point landing, is east, varying from 60° to 70°, while at Crag Harbor and the old Crown Point ore bed, it is from 30° to 40° west; a very remarkable change in the dip of the strata in the same rock and the same neighborhood.*

Besides the iron and limestone, I discovered a valuable bed of the verd-antique marble near Cedar Point. At the surface it has the appearance of being a sound rock, and free from cracks and fissures so common in rocks of this kind. Use only can determine its value as regards its durability. Its beauty is equal to any of the marbles of this description. Polished specimens in the collection.

Transition rocks of Essex. Limestone, Shales, &c.

Of this class there are two, both of which occur along the whole extent of the lake, but rarely if ever extend more than four or five miles west. The transition limestone, together with the slates or shales, form the uppermost of these rocks, and the sandstone which rests on the primary rocks is the other or inferior member of this class. The first, or the transition limestone, differs in no respect from that in other parts of the State, and is characterized by the same organic remains, as fucoides, the calymene, cyathophyllum, leptæna, orthocera, encrinites, &c. It terminates upwards in layers of shales and slates, limestones, or perhaps in what is generally considered as the true argillite, when the limestone is entirely concealed. The slates and shales derive their interest by this connection with certain intertruded masses of igneous rocks. One of these, and it is the most remarkable of them, may be seen at Cannon's Point and at Whaling's Bay. At both places it is intertruded apparently between the layers of slate. Its colour is pale reddish yellow, or yellowish red. It is a compact feldspar, in which are disseminated only sparingly small crystals of the same substance. It is therefore a porphyry. That the mass is an igneous product there can be no doubt. The shales, however, in contact with it, are unchanged. It would therefore appear, from this circumstance, that this mass of porphyry was protruded before the deposition of the shales, and that they were deposited upon and around the porphyry. In favor of this view it may be stated, that the shales are undisturbed in position.

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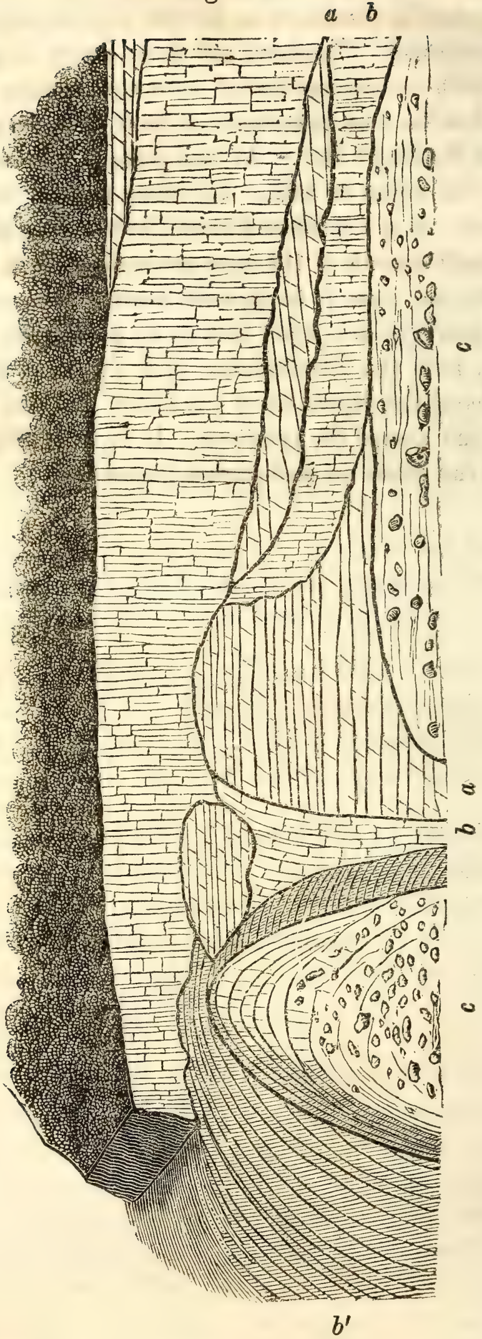
* The more so in a primary rock, as they preserve uniformity of dip for great distances.

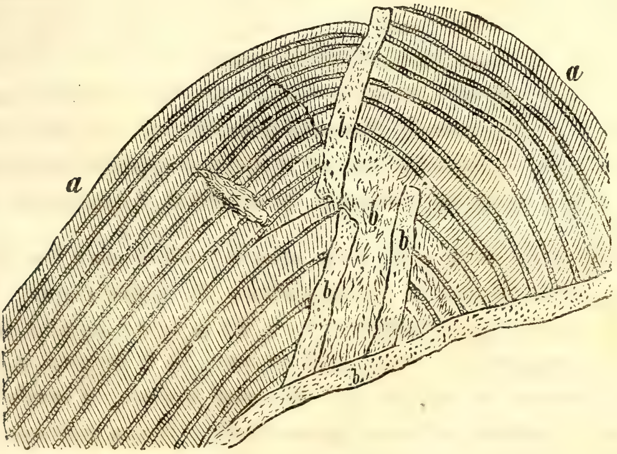
Fig. 14.



The cut (No. 14,) is a view of the porphyry dyke at Cannon's point; *a a*, shale; *b b*, porphyry; *b′*, porphyry separated into layers; *c*, beach with bebbles, &c. Another locality of this variety of porphyry, occurs north of the High rocks at a place called the Rattlesnake den. This is in primitive rocks. Almost the whole escarpment which rises 200 or 300 feet above the lake, is covered with fragments of the dyke which have fallen from the summit. I have just remarked that the shales were deposited on and around this porphyry dyke, and that they do not appear to have been disturbed since their deposition, but an uplift of the shales have taken place at another point above and near Split rock, not far from which the whole stratum may be seen bent upwards by the elevation of the hornblende rock on which they repose, or against which they lean. The porphyry near Cannon's Point, occupies an area of some acres, crosses the road near the point and spreads out in the adjoining fields. A beautiful dendritic variety occurs not far from the point on the west side of the road; it differs from common dentritic stone, that the surface exhibits no dendroidal markings, but the interior is decorated with beautiful infiltrations of colouring matter in the form of landscapes, trees, &c. It is probable that masses may be found which would form beautiful vases.

The shales are also traversed by dykes of a different character than the one at Cannon's Point. The most remarkable locality is at Juniper Island, south of Burlington. Fig. 15 is a view of a part of the dykes cutting through the slate on this island. The two vertical dykes are the oldest; the other, which is nearly horizontal, cuts off the other two, and at the same time displacing them and crushing and deranging the layers of slate. *a*, Slate raised from a horizontal position; *b*, the several dykes.

Fig. 15.



It is unnecessary to comment on phenomena of this character in this place, only so far as to say, that it is evident that the dykes of Juniper Island are more recent than those at the point and at Whaling's Bay, inasmuch as the vertical one produced an upard movement of the slate and the horizontal or distinct lateral movement, while those at the two last mentioned places have not disturbed the slate at all.

Sandstone of Essex.

This I consider the same formation I have described under the name of the "Potsdam Sandstone."

Its position is evidently beneath the transition limestone and calciferous sand rock. It is very deficient in organic relics, though not entirely destitute of them. It is unnecessary to repeat what has already been said of this rock; it is purely quartzose or siliceous in its composition, and finely stratified. It dips to the northeast at Port Kent, at an angle varying from 5 to 10°. The places where it occurs along Lake Champlain are indicated on the map of a part of this county, to which I refer the reader. This rock at Keeseville has been rent in the most remarkable manner; several fissures, the principal one of which extends nearly a mile, and through which the Ausable flows, have been opened by some convulsion in nature to the depth, in some places, of a hundred feet, and from five to twenty wide. Near the bottom of the fissure at the High Bridge, as it is called, I discovered numerous specimens of a small bivalve molusca, a lingula. I found also, on examination, that the same fossil occurred through an extent of seventy feet at least, and so far as I could discover, it was the only fossil enclosed in the rock. It is extremely thin and delicate, yet the shell is perfectly preserved, and is probably one of the oldest inhabitants of the globe, as the rock in which they occur is the oldest of the transition series.

Another phenomenon of some interest, which may be seen at the depth of 70 or 80 feet in this sandstone, are ripple marks. This fact does not appear quite consistent with the received opinion that ripple marks are made only in very shallow seas, for it appears more consistent with reason to suppose that this vast stratum of sandstone must have been deposited in a sea of great depth. It is a question, however, difficult to solve.

As a natural curiosity, the High Bridge of Keeseville is worth a visit from the traveller; it is truly one of the wonders of the northern district. Besides presenting a grand view of strata superimposed one upon another, it opens an interesting field for reflection on the nature of the agent which has thus rent the solid earth and torn apart the strongest plates which encircle it.

The examination of this chasm will also show us how, after the rent is made, the materials necessarily broken up may be removed by a powerful current of water, by which the breach will increase in width until it becomes a deep valley, bounded by an escarpment more or less abrupt.

Some valleys in St. Lawrence county, seem to have been formed in this way. The cracks or rents pursue uniformly a given course, without turning much to the right or left. In many instances, undoubtedly, the course of rivers is determined by these rents and fissures, and circumstances may so modify them that they may become the sites of long narrow lakes, similar to Lake Champlain. A stratum elevated by an upheave will probably attain a greater elevation along the line where the greatest force operated, and from this line it will dip like the roof of a house; the line of greatest elevation would suffer a fracture. An extensive removal of the ruins of such a stratum might form the channel of a river or the site of a lake. The dip of the rocks on the shores of the Champlain, and on the banks of the St. Lawrence river, is such, that the bed of one and the channel of the other may have been formed in a way analagous to the one here suggested.

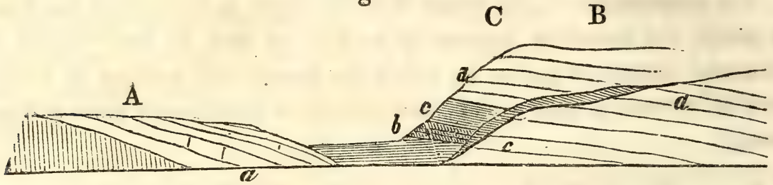
In concluding my remarks on the transition rocks of St. Lawrence and Essex, I consider it proper to add the following:

1st. The whole series evidently belong to the grauwacke group of European authors. One of the members of this group, however, is more developed here than in Europe, or even in any other section of our own country; this is the sandstone just described. That it is a distinct, separate and independent stratum, cannot be doubted by any one who will examine it in St. Lawrence and Essex counties. It is true that it passes into the calciferous sandrock; still the sandstone without a particle of lime is as extensive as the calc. sandrock of Eaton, and so far as I have observed never alternates with it, but is always beneath.

2d. The relative position of the whole grauwacke series is exhibited to great advantage at Port Kent and Burlington, Vt. To show this I have introduced a wood cut, (fig. 16,) which embraces the sandstone of

Port Kent and Keeseville on the New-York side; and the shale, the grauwacke and gray limestone of Burlington, on the Vermont side.

Fig. 16.



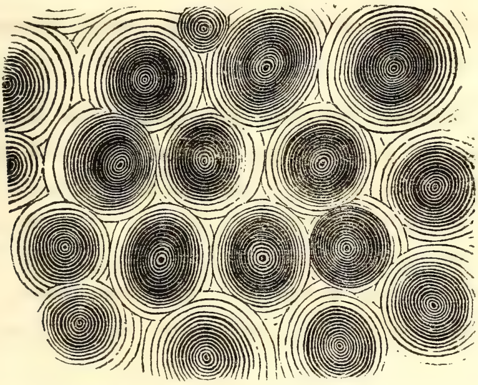
A, Port Kent; B, Burlington; C, Sharp Shins; *a*, sandstone resting on the primary rocks; *b*, shale; *c*, grauwacke sandstone; *d*, gray limestone.

We have at these points the whole formation in place in the order of superposition, except the transition limestone, which is of course concealed by the water of the lake, for the shales every where rest upon or terminate this stratum. 1st. We have the sandstone of Port Kent dipping beneath the waters of the lake and towards the east, and resting on the primary rocks. 2d. On the Burlington side the first stratum which appears, is the shale; then 3d. The grauwacke sandstone, and finally the gray limestone. Now the most important fact in this section is the position of the last member of the group, the gray limestone. It is a stratum which in Berkshire county, and other parts of the country, has generally been placed among the primary rocks; it is identical with the limestone at the base of Saddle mountain, and which covers more or less of the western flank of the green mountains. As yet I have not been able to find any very distinctive difference between it and the white and gray marbles along the whole range just mentioned. No one has ever doubted the primary character of these marbles, yet, if the preceding views are correct, will they not have to be removed into the *transition class?* That there is a well marked difference between the marbles and what I have in another place described as the *true primary limestone*, I cannot doubt. The whole matter evidently requires a re-examination, and if the above remarks lead only to this result, I shall be repaid the labor of all the attention I have bestowed upon them, though other opinions than those expressed above are finally adopted.

Tertiary of Champlain.

In the report for last year this formation was spoken of, but no attempt was made, at that time, to determine the extent or character of the beds. I have since ascertained that they consist of clays and sands, embracing, to some extent, marine shells, or relics of a very recent date. The whole formation is thin, not exceeding, at any place in Essex county, 50 feet, and averaging about 20 or 25 feet. Reckoning from above downwards, the strata are, first, a fine white, or yellowish white marine sand; second, a yellowish clay; and third, a blue clay. The organic relics are distributed mostly through the sands and yellowish clay.— The latter effervesces strongly with acids, and contains, at some localities, immense quantities of argillo-calcareous concretions, of all shapes and forms, and which appear to have been formed by molecular attraction, since the deposition of the beds. Another kind of concretion, quite as remarkable, is abundant in this formation. It is of a stalactical shape, and composed of concentric layers of clay, coloured by the oxide of iron, a thing much resembling an organic body, and if I mistake not, has been considered as such, but without sufficient evidence. These bodies are cylindrical, and are usually vertical in position, with a small hole piercing through the centre of each. Sometimes they are solitary, and sometimes they form, as it were, groups or clusters. Fig. 15 is a transverse section of a group of these curious bodies, and about the natural size. Sometimes there may be traced from near the surface, a straight fibrous root, leading to the centre of each of the cylinders.— This appears to have been sometimes the nucleus around which the particles began to form. Whether this root, like fibre, is animal or vegetable, I have not yet satisfied myself; but I consider the cylindrical bodies to be inorganic, and to have been formed by molecular attraction alone. If these views are correct, it goes to show that changes may take place in rocks subsequent to their consolidation, and that internal movements may alter materially the internal structure of the rock; and one which at first was a mechanical deposit may subsequently become highly crystalline. On the New-York side of the lake the tertiary does

Fig. 15.



not form a continuous deposit from the head of the lake to its outlet, but interruptions occur along the margin, wherever the primary strata reach the lake shore, so that it properly occurs in small insulated basins, whose extent from the shore rarely if ever exceeds four miles. On the Vermont side the tertiary covers a much greater extent of surface, and reaches from the lake to the base of the Green Mountains, or from 6 to 12 miles. The heighth above the level of the lake to which the tertiary extends is about 200 feet. This fact I considered an important one to settle, with some degree of accuracy, as it would enable me to to estimate approximately the actual extent of the ancient sea from which this deposit was formed, and by it also be able to identify with the tertiary of Champlain, an analogous formation on the Hudson river, which has been considered as belonging to a much older, and also to an independent basin. I refer particularly to the Albany clay and sands, concerning which there are many questions difficult to solve, on account of the absence of organic remains. That I may enable the reader to judge for himself on these points, I shall briefly state a few of the most important facts bearing upon this question.

1. The summit level of the Champlain canal, between Troy and White Hall, is 147 feet.

2. I have stated above, that the heighth above the lake, to which the tertiary extends, is at least 200 feet. Other evidences exist of the former extent of the sea, as the water worn surfaces are still distinct on the primary rocks. Under the present conditions of the water levels then, this ancient sea would not only occupy the Champlain basin, but the Hudson also, so that there would be a long continuous arm of the sea extending from the Gulf of St. Lawrence to the mouth of the Hudson, at New-York.

3. If we may rely at all on mineralogical characters, the tertiary clays and sands of Champlain may be traced far south of the lake towards the tide waters of the Hudson. The marine exuvia have as yet been found only on the borders of the lake, still it is not at all difficult to identify it by other characters.

The above remarks are made on the supposition that the land levels at the time of the deposit of the tertiary were the same as now, a condition which could not exist without an additional supposition very difficult, if not impossible to support, viz. that the level of the ocean has changed since this deposit was formed.

The idea is not new that this section of country has been submerged under an ocean, an idea perfectly correct, and substantiated by facts, which all must admit; yet the notions which prevail in relation to its drainage are absurd in part, viz. that it was effected by the wearing down of barriers by river currents. Now a barrier may be worn down to the level of tide water, and fresh or salt water lakes situated above tide, may be drained in this manner to that level; but an arm of the sea could not be drained, and the only way a change could be produced in the relative levels of land and sea, would be by the elevation of the former above the latter. It is in this way the ancient sea has been displaced from the Champlain basin. That this basin could not have been an insulated salt lake, is evident from the fact, that the present level of the Champlain is only 93 feet above tide water, and as its level must have extended 200 feet above the present level of the lake, it would of course communicate with the sea by the St. Lawrence channel on the north, and the Hudson on the south, converting it at once into an arm of the sea.*

If these views are correct, we can see no serious objection to the position, that the tertiary of Champlain, and the clays of the Hudson river belong to one formation, notwithstanding the absence of marine shells in the latter, especially when it is considered that they are not at all constant in the former, and are also wholly wanting in extensive districts which no doubt belong to this tertiary, inasmuch, that they are continuous with it, and in truth parts of it, an assertion which any one may prove for himself by an examination of the long narrow valleys of Lake Champlain and the Hudson river.

I have already stated that the sea has left marks of its wearing action on the rocks in the neighborhood of the lake, far above its present level. An interesting locality of this kind, may be seen on the road north of West Port, towards Essex. The road passes through two parallel ridges of granite, between which there is just space enough for it to pass. It appears that between these bluffs the tide ebbed and flowed with some violence, as they are worn smooth on both sides. On the west, the softer portions of the rock are worn out like a long cylindrical excavation. Fig. 17,

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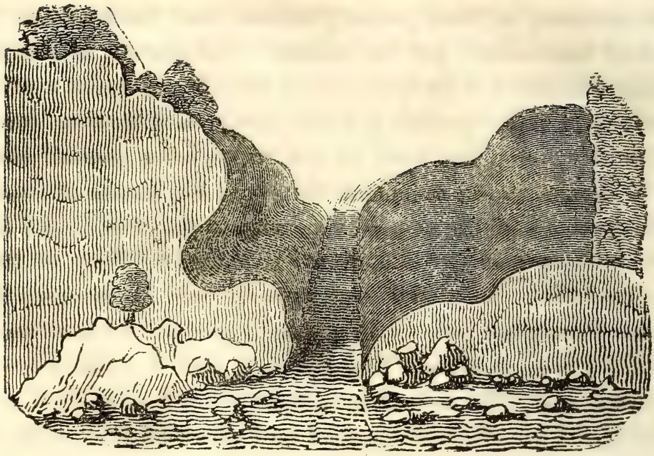
* These are the reasons which lead me to maintain that the drainage has been effected by an *uplift* of the land, and not by the wearing down of barriers by flowing water. During the time, therefore, when the tertiary deposits were forming, the long valleys of the Champlain and of the Hudson, were each so low that there was a direct communication between them by an arm of the sea.

Fig. 17.



is a cut representing the present appearance of these bluffs. They are about 150 feet above the lake.

Fossils of the Tertiary of Champlain.

The fossils at present known as belonging to this formation are few in number, and will appear as a meagre list when compared with the upper secondary of the Atlantic coast. Of the most common is the sanguinolaria, and saxicava, a species of modiola and mytilus, both undescribed as fossils, and a balanus; also a few bones, apparently fossil, belonging to undetermined species. Fragments of shells of other genera than those named above, too imperfect for determination, were met with at several places. It is probable, therefore, that the list will be much increased by future research. All that has yet been discovered, belong to species still living in the ocean, so that, geologically speaking, the formation is comparatively recent. It seems to be admitted or established, that a formation is the more recent, in proportion as the organic relics are similar to these now existing, and the more ancient, as the same bodies, or the greater proportion, differ from those inhabiting our present seas and continents.

Character of the Springs issuing from the Tertiary beds.

The water of this formation is not only hard, in the common acceptation of the word, but is often highly charged with sulphate of magnesia, and sulphate of lime. Efflorescences of these salts, form in dry weather on the banks of clay in the vicinity of Crown Point, and may be collected in a pure state. Some wells in Addison, in the same clay, are so highly charged with Epsom salts, that they cannot be used except as reservoirs of rain water. I conjecture, therefore, that this stratum contains large quantities of the sulphates, and probably carbonates also. As there can be little doubt but that the carbonated springs at different locations, belong to the same formation. There is a great uniformity in the character of the water in the clays of Champlain, St. Lawrence, and the Hudson. All of them contain the sulphate of magnesia, more or less, at different places. This salt is evidently diffused through the whole body of it, but more abundant in some locations than others, and its diffusion and incorporation with the clays, shows, by analogy, that other salts may also be diffused through certain rocks, and constitute reservoirs of saline matter, without the existence of solid beds. It goes to confirm the views of Prof. Eaton, expressed long ago, in relation to the brine springs of the west. A specimen of saline water, taken from the spring near Crown Point, had a specific gravity of 1,014. A thousand parts, by weight, contain 18.78 of saline matter, the greater part of which is sulphate of magnesia, with a portion of sulphate of lime.

Economical uses of the Clays.

The clays of the tertiary beds, more particularly the lowest stratum, usually called *blue clay*, are suitable for the manufacture of brick and coarse pottery. The presence of carbonate of lime renders it easily fusible, and of course unfit for the manufacture of those articles requiring great heat. Search should be made for beds of clay, free from lime, and those may perhaps be found in the very lowest of the strata.

The upper stratum of the yellow clay will serve an excellent purpose in the sandy soils, more or less common along the whole extent of the lake, especially where the shells are the most abundant. A liberal use of this marly clay cannot fail to benefit the loose and porous sands, similar to those of Keeseville, Port Kent, &c. Those clays which are charged with the sulphates, as sulphate of lime and magnesia, in addition to their valuable properties as marly clays, or those containing carbonate of lime, have an additional value as manures. It is desirable that those who have it in their power to experiment on the use of clays* and sands, in changing the condition of their arable lands, will

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* The following paragraph was observed in the Boston Traveller, after the above was prepared, which I take the liberty to copy.

CLAY.—As the beneficial effects of clay on light and sandy soils is so generally understood and acknowledged, we are surpirsed that it is not more extensively used in ameliorating the condition of soils of this nature. A gentleman of this town informs us that in many cases he considers clay altogether preferable to manure, from his own experience in the matter. Four or five years since, he had carted, on a lot of small extent, a considerable quantity of clay, which was spread over the surface to the depth of three or four inches. This was left until dry, when it was rolled; the lot was then planted with potatoes, which yielded a great crop. The succeeding year the lot was ploughed, and seeded down with hemp; the crop that follow-do so, and communicate to the public the results; by which they will confer a great benefit on community.

The use of plaster, and the clover crop, has restored to the farmer acres of land which had lain waste and useless. A modification of this mode of husbandry, by the use of clay, or the marly clays especially, would undoubtedly produce effects more permanent, than the plaster alone; for the produce of such soils must diminish as the vegetable matter furnished by roots of clover is exhausted. But the retentive power of the soils will be doubly increased by clay, and render them capable of holding the manures applied to them, a much longer period; in other words, the water, which percolates through the sands, readily, and without obstruction in their natural state, and which will carry the soluble part of the manure along with it, will be held by it, or retained, when the sands are compacted by the use of clay. The function, therefore, which clay performs in a soil is partly mechanical, a function of the highest importance, as we may know by examining those wastes which are entirely destitute of alumine, known under the name of *deserts*.

In concluding my account of the tertiary of Champlain, I beg leave to remark,

1st. That it is probably the most recent marine formation yet known in this country, still it must be considered too ancient to be ranked among the modern deposits. The evidence of its newness rests, as has been stated already, on the remains of moluscous animals, the genera of which, and probably the species, still exist in the ocean. Therefore, the changes in climate, and other modifying conditions, cannot have materially altered since the clays and sands of the Champlain basin were deposited.

I have remarked that it is too ancient to be ranked among the modern deposits; in this statement or conjecture I am borne out in part by the fact, that above these clays, &c. we have the modern group composed of boulders, pebbles and sands. Of boulders, we find them mostly distributed above this formation; and of the pebbles and sands there is a thick overlaying stratum, entirely distinct in its mineralogical characters, being composed of the debris of the surrounding mountains, and distinguished from it by containing iron sand, schorl, garnet silicious and

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lowed was the heaviest raised in this country that year. In the fall of the same year the lot was again ploughed and seeded down with wheat, of which it produced an extraordinary crop. This wheat crop brought the highest premium in this commonwealth. The land has been liberally manured, and has since yielded great crops of hay. In this case there has been evidently a great improvement of the soil, and similar treatment of light soils would doubtless be followed by similar effects. If we were a farmer we think we should try it.—*Greenfield Gaz.*

felspathic particles, coarser than the sand of the tertiary under consideration, and besides the mineralogical characters, we have the evidence of superposition in many places.

The time necessary for the removal and transportation of sands from the neighboring mountains to the valleys, was necessarily great, for it is a process which must proceed slowly, especially if affected by the agency of causes now in operation.

In the 2d place, it will be seen that this formation is extensive, occupying, if the views I have presented are correct, not only the Champlain valley, but the St. Lawrence and Hudson also. It is, therefore, important on account of its extent, and will require for its perfect elucidation much attention and study.

In the 3d place; this whole formation has been deposited subsequent to a remarkable geological epoch, the date of which I am not able to fix. This epoch is marked by the wearing down and polishing of the transition rocks of Champlain, particularly the transition limestone. The polished surfaces always pass beneath the tertiary, or in other words, the tertiary rests upon, defends and preserves those surfaces, clearly proving that since those currents passed over this valley, the tertiary has accumulated.

In the 4th place; the depth of Lake Champlain is at least 600 feet, as soundings have been made at one place to that depth without bottom. A large portion of the waters of the lake are therefore below the level of the sea. This long deep chasm is, however, constantly filling up by debris from the adjacent mountains. In fine, a fresh water deposit is rapidly making, which will be characterized by uenios helices, &c.

In the 5th place; among the geological changes which have taken place in the Champlain valley, the elevation of the tertiary beds seem to have been the last. Whether this uplifting from the depths of the sea was produced gradually, or was effected by one or more movements per saltem, is not determined; our data are insufficient on which to form an opinion. Still more difficult is it to form an opinion on the questions, whether this valley has attained its ultimate height, and is to preserve its present level; the only clue we have in the decision of these questions is, that disturbing forces have acted but feebly for many geological ages, and therefore it seems probable that they sleep quietly far beneath the surface, not again to be awakened into energetic action.

Visit to the Mountains of Essex.

During the month of August last, I visited the mountains of Essex with a view of determining the position and height of some of the most conspicuous elevations at the source of the Hudson.

This tour of exploration was made in company with a party devoted more or less to scientific pursuits, a part of whom were also personally interested in the survey.

In the prosecution of our objects, it is but justice to notice in this place, the aid we received of the Hon. A. McIntyre, of this city, and D. Henderson, Esq. of New-York, inasmuch as they liberally supplied every thing necessary to secure the success of our enterprize. Indeed, the party were but their guests, whether at the little village of McIntyre or on the mountain summit: an instance of liberality I take the liberty thus publicly to acknowledge.

It is not my object to write an account of this tour; this has already been given to the public by Mr. Redfield, of New-York, in the Journal of Science, and is a valuable document. Notes of a visit to this romantic region have also appeared in the New-York Mirror, in the beautiful style of the editor of that popular periodical. They contain a fund of pleasing anecdote.

The points of greatest interest to us were, to determine the height of three or four peaks in the neighborhood of the source of the Hudson, and also the height of one of its sources at its extreme point or origin. To accomplish these objects, we ascended the east branch of the Hudson to its source, which we found to be in a small mountain meadow, 10 or 12 miles N. E. from the iron works at McIntyre, and at the base of the summit of what finally proved to be the highest point in the group of mountains. In the same meadow, one of the branches of the Ausable takes its rise; so that it constitutes the pass, and probably the highest, between the waters which flow into the Atlantic on the south, and those which flow into the Gulph of St. Lawrence on the north. The height of this meadow is 4,747 feet.

Our route up the east branch was one which furnished many interesting facts in a geological point of view, one in particular, the effect of attrition on the boulders which are in their course down to the lower levels. It seems that although at the commencement of their journey they are huge and unweildy, yet before they reach their final resting place, they are reduced to the size of what we call stones, and even in many instances to gravel. As the rock is peculiar, and well characterized through the whole region of the upper Hudson, it is very easy to recognize it. It is, however, rare that we meet with it far down the main branch of the Hudson; in fact I doubt whether it is possible to find a pebble of this rock in the course of this river below Glen's Falls. The fact is, before they reach the wide and deeper portions of it, they are ground to powder. If this is not true, we should frequently find masses of this rock along the shores of the Hudson, which have been transported either by the force of spring freshets, or by ice at the breaking up of the streams.

The region in which the east branch of this river rises, it seems had never been explored previous to our visit; and it is not unreasonable to suppose this, for all our writers on geography have uniformly underrated its height, have made incorrect statements in relation to the origin and course of the principal branches of the Hudson, and also in relation to the character of the whole mountain group in which they rise.

This being the case, it is not surprising that names have not been given to the highest points of land in the State. This privilege belongs by common consent to the first explorers. This, to be sure, is of but little consequence; still, as things must have a name, the party saw fit to confer upon a few of the highest summits designations by which they may in future be known. As this tour of exploration was made by gentlemen who were in the discharge of their duties to the State, and under the direction of the present Executive, whose interest in the survey has been expressed both by public recommendation and private counsel and advice, it was thought that a more appropriate name could not be conferred on the highest summit of this group than Mount Marcy. Its approximate bearing from Bald Peak, in West Port,* so well known on Lake Champlain, is N. 81° W. Its true bearing from the Dial Mountain is N. 73° 13′ W., and the bearing of Bald Peak from the last named mountain is S. 85° 48′ E.; and from the same, White Face bears N. 13° 47′ W., with an angle of depression = 0.15′. The bearing of White Face from Mount Marcy on the magnetic meridian is N. 10° 30′ E., and of Bald Peak, S. 80° E. Clear Pond, at Johnson's, S. 21° E. and Mud Pond, 2½ miles N. towards the Dial Mountain, S. 51° 30′ E. The Newcomb farm and clearing, S. 61° W., and Pendleton settlement S. 65° W.; Camel's Rump, in the Green mountains, N. 87° E.; Mountain Meadow, source of the Hudson and Ausable, N. 70° E.

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* This mountain is six miles from Moriah Four Corners, bearing N. 20° E. (Magnetic.)

Another remarkable mountain, bearing N. 47° W. was named Mount McIntyre. It was supposed to rank next in height to Mount Marcy. Its true bearing from the Dial mountain is N. 66° 36′ W. The bearing of White Face from Mount McIntyre, on the magnetic meridian is N. 20° E., and the Notch, or as it is now called, the Indian Pass, S. 85° W. North Peak of Santanoni, S. 72° 30′ W. and the South Peak S. 65° W. N. W. point of Lake Placid, N. 5° E.; Long Pond, in Keene, N. 50° E.

An insolated mountain, situated between Mount Marcy and Mount McIntyre, has been named Mount McMartin, in honor of one now deceased, whose enterprize and spirit, in conjunction with two others, whose names it is unnecessary to mention, has contributed much to the establishment of a settlement at the great ore beds, as well as to other improvements, advantageous to the prosperity of this section of the State.

A distant view of this mountain is given from Lake Henderson. It is particularly remarkable for its trap dyke, which is about eighty feet wide, and which has apparently divided it into two parts near its centre. A portion of this dyke is visible from Lake Henderson, a distance of about five miles. A fine and spirited view of it has been furnished me by Mr. Ingham of New-York, who was one of the exploring party. It was taken near the base of the mountain, at Avalanche Lake, and is merely an exhibition of the termination of the gorge which has been formed by the breaking up of the dyke by a small stream of water, assisted by frost and other agents.

The cluster of mountains in the neighborhood of the Upper Hudson and Ausable rivers, I proposed to call the *Adirondack Group*, a name by which a well known tribe of Indians who once hunted here may be commemorated.

It appears from historical records that the Adirondacks or Algonquins, in early times, held all the country north of the Mohawk, west of Champlain, south of Lower Canada, and east of the St. Lawrence river, as their beaver hunting grounds, but were finally expelled by the superior force of the Agoneseah, or Five Nations. Whether this is literally true or not, it is well known that the Adirondacks resided in and occupied a part of this northern section of the State, and undoubtedly used a portion at least of the territory thus bounded as their beaver hunting grounds. This name is not so smooth as Aganuschioni, which has been also proposed as a name for the group, but the above historical fact has induced me to propose the one given above.

A correct idea of this central group of mountains, or the Adirondacks, as we shall hereafter call them, may be gathered from our profile view. It is strictly alpine in its essential features, but in fact, when absolute height is considered, only so in miniature. It is, however, the only one in the State which approaches at all to this character.

It will be perceived, by inspecting the table of heights on the next page, and comparing them with the measurement of last year, that no less than four of the summits exceed that of Whiteface. One of them, viz. Mount Marcy, is the peak Mr. Hall and myself pointed out last year as the highest point in view from that summit, and as exceeding it also in elevation by six hundred feet, as I have this year shown by measurement.

The group, taken as a whole, is more lofty than the White Hills of New-Hampshire, though the main summit, Mt. Washington, exceeds Mount Marcy by 767 feet; for there remain unmeasured many peaks which will exceed or come up to 5,000 feet, besides those now given in the table.

It will be interesting to the meteorologist to study the effect and influence which this section of high land must have on the mean temperature of the surrounding region. It must necessarily reduce it perceptibly over a wide extent of country. This position will be admitted more readily when I state the fact, that large banks of snow remain on Mount Marcy until the middle of July, or until the 17th, as was observed by Mr. Johnson at Clear Pond, this last year; besides we have reason to believe that ice is formed there every night during the summer.

I give below the result of a part of the observations on the topography of Essex, selecting those which relate to the height of the most elevated peaks and highest passes. A part of these results were obtained trigonometrically, and a part barometrically. I have copied the reduction of the barometric observations of Mr. Redfield, as given in Silliman's Journal, so far as these observations were made in concert.

Bulwagga Mountain, 1,260 feet above Lake Champlain.
East Moriah, Four Corners, 790 do do do
Pass, or Road Summit, 9 miles from Lake Champlain, 1,546 feet.

West Moriah, at Weatherheads, or Schroon Valley, 1,117 feet.
Pass of the Schroon Mountain, 1,375 feet.
Johnson's, at Clear Pond, 2,012 feet.
Pass between Johnson's and McIntyre, 2,592 feet.
Boreas River Bridge, 2,026 feet.
Hudson River Bridge, 1,810 do
Inlet at Lake Sandford, 1,826 do
Iron works at McIntyre, 1,889 do
Lake Henderson outlet, 1,936 do
Lake Colden, 2,851 do
Avalanche Lake, about 2,900 do
Highest source of the Hudson and Ausable Rivers, 4,747 feet.
Mount Marcy, 5,467 feet.
Mount McIntyre, 5,183 feet.

Summit of the pass between Lake Henderson and Preston Ponds, one of the sources of the Racket river, 2,223 feet. These ponds are about four miles east of McIntyre, and are only 150 or 200 feet below the pass.

Bald Peak, in West Port, 2,065 feet.
Dix's Peak,* 5,200 feet. Approximation by levelling.
Dial Mountain,† 4,900 feet. Approximation by levelling.

Height of the barometer at Johnson's, August 29, 2 P. M. 28 in. temp. 71° F. At the Notch, in Keene, 100 feet below the pass at the base of Dial Mountain, barometer 27 in. temp. 50°, 5 o'clock P. M. August 30. This last observation was made near the source of the Schroon river, leaving out that portion which flows from near the summit of the mountain.

The height of the pass between the Schroon and Ausable, 2,756 feet, adding 100 feet for the rise above the point where the observations were taken.‡

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* Highest peak of the Schroon range west of Weatherheads.

† Known under the name of Nipple top at Johnson's. It is probably within the bounds of Keene, and is there called the *Noon mark*.

‡ The barometric observations were calculated by Mr. Redfield, by the formula and tables of M. Oltmanns, as given by De La Beche in the appendix to the Geological Manual. As I used a different formula last year, I have compared the result as obtained by Mr. Oltmanns with this. I find a material difference, and, taking all circumstances into consideration, I believe the formula I use more accurate than the other. The formula is as follows:

That I might carry out the plan of the survey not only in relation to its specific objects, but extend it to those not distinctly recognized as such, I commenced last September a series of observations on *magnetic variation*. In conducting these observations I associated with myself Prof. A. Hopkins, of Williams College. Our joint design was to ascertain the variation of the needle from the true meridian at all the principal places in the northern section of the State. We sought to obtain results as near to perfect accuracy as the instrument we used would permit, for the value of all such observations depend entirely on the delicacy of the instruments and care in making them, and we doubt not that, so far as practical application is concerned, they may be relied upon, particularly in the allowance to be made for variation in land surveys. In our intercourse with gentlemen who are practical surveyors, we found they had no general rule to guide them, and were often, if not always, at a loss to know what amount of variation they might allow. I deem it unnecessary to state further the reasons or facts showing the importance of a series of experiments on magnetic variation and intensity at different places; I shall therefore follow these remarks with an abstract of our observations. It was furnished by Prof. Hopkins, who has introduced into this abstract some general views which merit particular attention.

" The extensive iron deposits, which were noticed in the report of the last year, constitute one of the most interesting features in the northern geological section of the State. Considering the importance of these deposits in an economical point of view, nothing which may serve to throw light upon their value or extent, can be regarded as irrelevant to the purposes of this survey. In the present instance, there appears to be a mode of establishing some general conclusions, at least, to which a clue could not be furnished by those indications on which the geologist ordinarily relies. This is to be found in the influence of large ferruginous masses upon the magnetic needle. Deposits, far less extensive than those which abound in Franklin county and Essex, are known to exert a local attraction, sufficient to derange the general directive ten-

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$$\frac{30\,(87 \pm 0.21\,a)\,d}{m} = \delta \times 2.83.$$

d = Difference of mercurial heights in tenths of an inch.
a = The difference between the mean temperature of the air and 32°.
m = The mean height of mercurial columns at the two stations.
δ = Difference of mercurial temperature.

The height of Mount Marcy, calculated according to this formula, is 5,594 feet, without allowing for cistern variation, and is about 1,800 feet above the Catskill. As the whole subject will be reviewed and corrected, and as many additional facts are to be added to the above, I consider it unnecessary to dwell upon it at this time or to make any further alterations.

dency of the needle, and render it entirely useless as an index to the true meridian. Nor would it be at all surprising, even where no local derangement might be apparent, should the needle be found to deviate some minutes, or even degrees, from the true magnetic north. Such a deviation, ascertained by experiment at different points, might furnish a valuable criterion by which to judge of the proximity of iron, of the direction of the bed or vein, and perhaps its extent. This might especially be expected, were much of the iron (as is the case in this district) of that kind known under the name of the *magnetic oxide.*

With views like these, although no provision has been made by the State for such experiments, it has been thought worth while to incur some private expense, with a view to determine whether any data of value could be ascertained by the aid of the needle. For this purpose, a small theodolite was procured, with a needle attached to it, and experiments made at several points, the results of which will be found annexed. It may be proper to premise, that the variation of the needle in this country at present is *west*, at all points east of a certain line, called the *line of no variation.* This line traverses the western and southern States, and appears itself not to be stationary. East of this line, the variation is increasing; at least this is proved to be the case at several points where experiments have been make.

At Williams College, in 1833, the variation was 6° 15′ W.
1837, " 7° 45′ W.
Showing an annual increase of 22′ 30″.

The results annexed are deduced from observations made upon the pole star at its greatest elongation, and upon the sun at equal altitudes.

The first station selected was at Crown Point, about two miles south of the old fortification. As no deposits of iron are known to occur near this point, it was imagined that the needle would be nearly free from the influence of local attraction. The variation from the pole star, at its greatest eastern elongation, was found at this place to be 10° 57′. Making the necessary corrections, we shall find the variation of the needle from the meridian to be W. 8° 47′. This reduction supposes the latitude of the station to be 43° 55′, which can vary but little from the truth. The next observation was made at Cedar Point, near Port Henry, about six miles N. W. from the former station. Variation at this point, 9° 28′. At Moriah Four Corners, about two miles west, 10° 10′. Proceeding still west, to a small pond, estimated at about six miles from the Corners, on the main road to West Moriah, the variation was found to be 7° 18′. The next observation was made at Weatherhead's inn, in West Moriah: variation, 7° 1′.

By comparing these results, it will be perceived that the variation increases from Crown Point to Moriah Four Corners, and from thence decraeses to Weatherhead's, estimated at about 13 miles west of the Corners; so small a number of miles occasioning a deviation of 3° 9′. It will be perceived, also, that at East Moriah (Four Corners) the variation is greater than is due to the general influence of the earth. We should be led, therefore, to infer the existence of some cause of local attraction between Weatherhead's and the Corners, and probably in the vicinity of the latter place, as the variation at Weatherhead's is nearly that which is due to the earth's influence, on that meridian.

Such a cause actually exists, in those extensive ore beds which have been opened at no great distance from the Corners, in a direction N. W. These, doubtless, exist beneath the surface in a direction west, and are quite sufficient to account for the deflection of the needle, already mentioned.

The inn of Weatherhead, in West Moriah, stands on a plain, small, but strikingly characterized by the bold and uncommon outline of those mountainous masses, along the eastern skirt of which this plain extends. One of these mountains attains to an elevation of between four and five thousand feet above the plain; the plain itself, as indicated by the barometer, being about 1,117 feet above Lake Champlain. This mountain, we ascertained by the theodolite to rank second in height to none in the State, with the exception of Mount Marcy.*

Finding the needle to assume nearly a neutral position on the plain just described, we were anxious to penetrate still further into the interior. Entering the woods, accordingly, and proceeding about nine miles, we made another observation, and found the variation W. 8° 16′. Here we employed packmen, with a view to visit a mountain,† which rose from the forest many miles north, and which appeared to be among the highest of the group. After encamping out two nights, we reached the summit of this mountain, on the morning of the third day. The clouds which enveloped its sides, at an early hour, happily melted away just at the time of our arrival, giving us an opportunity for an observation on the sun. Wishing to obtain the bearing of the more important mountains in the vicinity, we watched, with an interest, in which it is difficult to say, whether our love of science or admiration of the intrinsic beauty and sublimity of the scene most participated; the lifting up of the cloudy envelope from the neighboring summits, one after another, in the order of its elevation, presented its outline, dim or well defined, according to the distance, until the profile, in every direction but that of a single mountain, was complete. From this, a little before noon, the mists were dissipated, revealing the summit of Mount Marcy, the loftiest in the group and the highest land in the State, bearing N. 73° W., and at an angle of elevation of 1° 36′ above us. The variation of the needle at the elevated point where we now were, was found to be 9° 33′—leaving little room to doubt, when taken in connection with the last mentioned observation, where the variation was found 8° 16′ (less than where we now were but greater than at Weatherhead's) that we were coming within the sphere of some general disturbing influence, lying in a region still further west. Whether this is to be sought for in the immense iron deposits at Newcomb, described in the report, or in some cause less remote, remains to be determined by future observations. It should be mentioned, that in the gulf beneath the mountain east, where we encamped the following night, the variation was found to be only 7° 8′. Whether the heavy mountain west served in a measure to neutralize the influence in that direction, or whether some local cause east of us produced the effect, it is impossible to say.

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* Dix's Peak.

† Dial Mountain.

Other observations were made in the course of the tour; but those already stated will be sufficient, it is believed, to confirm the remark, that the needle in this region is subject to extraordinary influences, which cause a deflection from the true magnetic north, even where the needle traverses freely. A knowledge of the magnetic intensity, would evidently be of the greatest importance towards settling any question in relation to local influence. To ascertain this element, at different points on the earth's surface, has, within a few years, occupied the attention of some of the most distinguished experimental philosophers in Europe.—Extended observations have been made, by Humboldt, in Central and South America, and in Siberia, by Prof. Hansteen, under the patronage and at the expense of the King of Sweden. The instruments intended for the determination of this point, and indeed every other relating to the earth's magnetism, should be standard instruments, constructed by the first artists. The one employed by us, in the observations already detailed, was not susceptible of that accuracy which it would be necessary to secure, in case an extended and connected series of observations should be contemplated. In determining the propriety of instituting such a series (in the State) regard would be had, doubtless, mainly to practical utility. It is presumed, however, that the general interest of the subject, in a scientific point of view, would not be without its weight."

The connexion of magnetism with geology, is more intimate than it may appear to be to persons who have not informed themselves of the progress and present state of the sciences. In evidence thereof, it may be stated, that magnetic, and electro-magnetic powers, are active in disposing and arranging the materials composing the crust of the globe; their action, however, being more particularly proved in the transfer of metallic matter, or in other words, the operation of these forces furnish us with one mode of explaining how mineral veins have been filled.

How much, or how influential these forces may be in the production of volcanic action, or whether they have had a distinct and perceptible influence in the general distribution of metallic matter, or how great their particular or general influence has been on the surface of the earth and in the depths beneath, we know not.

Experiment and observation have not been sufficiently extended to enable us to answer these questions satisfactorily. We may be assured, however, of the fact, that changes are gradually effected by means of these and other agencies, which appear to co-operate with them, whose combined effects are not likely to be overrated. Heat, light, electricity, chemical affinity, capillary attraction, though often slow and silent in their action, yet they work a great amount of change in time. A stick of lunar caustic, if placed on a metallic plate, or in fact, if only exposed to the light, undergoes an entire change in the arrangement of its component parts—the silver re-appears in its pure metallic state—the antique bronze medals are converted into protoxide of copper—the feldspar of a granitic column is perfectly decomposed by the laws of affinity, and by the operation of the same laws other bodies are re-produced, or re-composed, even in the tissues of organic bodies. Perfect crystals of calcareous spar, and of quartz, are developed from their solutions by electricity of feeble intensity, but acting for a long time. What takes place on a small scale in a particular instance, is but an illustration of what may take place on a great scale in the interior of the earth.

In an economical point of view, observations of this kind are not without their use. What we observe in Nature's own laboratory, may in many instances be imitated by us in ours; and if we cannot *imitate*, we may derive from her many useful hints. It is true, that Nature has at her disposal all time, and need not therefore be in haste to finish her work; she has, then, this advantage over us; yet this advantage is materially diminished when it is considered that we may command all the circumstances of a given case, and so arrange the forces we employ, or so concentrate their action, that we may accomplish in a few moments more than nature accomplishes in years. So far then from being her slaves, we command "*if we but obey her!*" She displays, however, a majesty in the pursuit of her ends, which may well excite our wonder and admiration, but which is far above our imitation—the winds and the waves, frost, heat, the earthquake, the internal fires, are only at her command, and at her will only, the earth heaves her bosom, and the mountain pours forth its floods of molten rock.

E. EMMONS.

Albany, Feb. 15, 1838.

APPENDIX

To the report of the 2d Geological District containing descriptions of two minerals supposed to be new.

Chiltonite?

Colour white and greenish white. Structure foliated or cleavage, distinct in one direction; planes curved and imperfect. Primary form? Lustre, on the cleavage surface, pearly; on the face of fracture vitreous or semi-vitreous. Translucent—transparent. Fracture uneven. Cohesion strong. Hardness = 6, sp. gr. 2.892.

Chemical characters.—Before the blow-pipe, in the outer flame, it instantly swells and becomes opake or milk white; in the inner, fuses readily into a blebby glass. With borax it fuses with intumescence into a colourless glass, and with salt of phosphorus into a slightly opaline or nebulous glass. In the flame of a candle or spirit lamp, a fragment becomes milk white and fuses on the corners and edges into a blebbley glass. Heated in a glass tube, it gives off water; it dissolves partially in muriatic acid, but does not form a jelly. From the muriatic solution oxalate and carbonate of ammonia throw down precipitates.

Observations.—The above described mineral I found in West Port, Essex county, embedded in the hypersthene rock, in small quantities. It resembles Prhenite in its external characters in part, or it has a general resemblance to it, but is sufficiently distinct to constitute a distinct species. It also resembles the family of feldspars, but it is evident it cannot be a species of that mineral. In the natural system it belongs rather to the family of kouphone spars than feldspar, or it might very properly be placed between those two families, immediately after Prhenite. I have not been able to procure but one distinct cleavage. Its primary form is therefore unknown. In chemical composition it is also allied to the kouphone spars, being unquestionably a hydrous silicate of alumina and lime.

The name of *Chiltonite* is conferred in honor of the late George Chilton, of New-York, whose merits as a mineralogist and analytic chemist, were highly appreciated by men of science.

2. *Eupyrchroite?*

Colour pale malachite-green, passing also into greenish white, and sometimes brownish. Structure indistinctly fibrous in the thin mammilated layers, which are arranged like those of green malachite. Colours of the separate layers various. Dull and opake. Hardness = 4, sp. gravity 3.06.

Chemical Characters.—Fusible before the blow-pipe with difficulty, after a long continuance of the blast, and on the surface only, into a glassy glaze. Decrepitates: with borax and salt of phosphorus it fuses into a pale bottle green glass when hot or warm, but transparent when cold. Heated to a point just below redness it phosphoreses with an emerald green light. Heated in a glass tube it gives off a little vapour. In muriatic acid it dissolves easily and perfectly with a slight ebulition; from this solution oxalate of ammonia throws down a white precipitate; also the carbonates of ammonia and soda an abundant white flocculent precipitate. The muriatic solution evaporated to dryness is perfectly redissolved by acidulated water.

Observations.—This remarkable mineral occurs at Crown Point, not far from the landing. It has a resemblance to malachite, somewhat in colour and structure, but evidently contains no copper. Its place in the natural system is in the genus Wavelline spar. It has in fact in its external or natural historical characters as well as chemical, quite a striking resemblance to Wavellite and Gibbsite. It occurs abundantly in tuberose and mammilated masses in gneiss.

Its name, *Eupyrchroite*, has an allusion to its beautiful phosphoresence by heat or fire.

In conclusion, it is proper to remark that it was not intended to describe the above named minerals in this report until it was too late to procure perfect analyses of them, though I was early satisfied they were not described in any work on mineralogy to which I have had access.

SECOND ANNUAL REPORT

Of so much of the Geological Survey of the Third District of the State of New-York as relates to objects of immediate utility, by Lardner Vanuxem.

The counties whose examination forms the subject of this report, are Montgomery, Herkimer, Oneida, and Oswego. These counties were chosen in consequence of containing the oldest, and therefore the rocks which form the base of the third district. We were influenced, moreover, in our selection, by the fact of these counties not containing the brine springs, and from their rocks being far inferior in position to the rocks of the counties south belonging to this district; the rock of those counties making the nearest approach, not only geographically but geologically, to the rocks in Pennsylvania which contain coal. From the circumstance of coal and salt being considered to be the two most important objects in the survey of the third district, it were highly desirable that all points or questions as to their presence or absence, and likewise the source or origin of the brine springs or salt water, should in the final report of the third district be definitively settled. Therefore it is, that their investigation is reserved to a future, and more mature period of the survey.

So, also, we have reserved the exploration of the unsettled parts of the counties of Montgomery, Herkimer, and Oneida, having examined just so much as would enable us satisfactorily to ascertain the class of rocks to which all such parts belonged. The unsettled parts which appertain to the third district, being but small compared with the great area of the same class of rocks embraced in the second district, it was judged advisable to await, and follow up the investigations of Professor Emmons, rather than commence with the little knowledge yet acquired of them. When we know how small is the distance in those wilds which can be traversed in a day, and how limited is the view, from the dense nature of the forest, and how short comparatively the period given to the whole survey, the greatest economy of time becomes necessary, for the realization of all its objects.

In order to aid the reader, to avoid repetition, and to condense as much as should be done, so as to confine the report to a reasonable number of pages, more especially as Montgomery, Herkimer and Oneida, have many rocks common to each other, a few brief matter of fact views of the general geology of these counties will be given. These views will tend to give method to the subject, and by pursuing the same plan in the subsequent annual reports, the whole will be connected together; thus avoiding what otherwise would be dry and meagre detail, incident to a mere citation of geological products, and locality of the same.

The series of rock which forms the third district, from the Pennsylvania line to the primary elevated region which separates the waters of the Hudson from those of the St. Lawrence, inclines at a small angle to the southwest, giving rise to that all-important practical consequence and fact, that every change of rock going north from the Pennsylvania line to the limits mentioned, brings us to a lower and an older rock; and on the contrary, every new or different rock we arrive at going south, carries us higher in the series, or nearer to the newest, the coal of Pennsylvania, the final member of the great consecutive series of rocks of our portion of the North American continent.

The different groups, or series, or formations, of the third district, have not all extended continuously over the limits mentioned, but appear, like the coal of the State mentioned, to have been restricted in their progress north within certain limits, by a well defined east and west line.

From the coal series to the Mohawk valley, the restriction or limit has been confined, so far as observations have been made, to a single series or group; but at the Mohawk valley, throughout Herkimer and Oneida, no less than five series terminate more or less abruptly, according to locality, giving rise to that great depression the Mohawk valley, or conversely, the high range or great elevation which in these two counties, and to the south of Montgomery, rises for a thousand or more feet above the river.

The valley of the Mohawk, therefore, forms in all that part which traverses the three above named counties, an all important geological line of division. A high and an abrupt elevation, caused by the appearance of the northern edges of the rocks of which it is formed, characterizes the southern side of the valley; whilst the northern side, being in general formed of the inclined planes of the surfaces of the rocks which pass under and support those of the great escarpement, presents nothing in common with its southern border.

The rocks whose appearance commences in the bottom of the valley and which extend north, are the black shale, (with its overlying green shale and sandstone,) the Trenton limestone, the birdseye, the calciferous sandrock and the gneiss. The arrangement being in the descending order. Thus the black shale, relatively to the four other rocks, is invariably the upper one, whilst gneiss is as invariably the lowest.

The black shale, the Trenton limestone, the birdseye, and the calciferous, in their course north from the river at different points disappear, finally leaving the gneiss, the oldest rock of the district, to form with its primary associates, the great northern elevations, and to cover the greater part of Montgomery, about three fourths of Herkimer as to length, and that part only of Oneida county which forms the town of Remsen, including that small triangle in the town of Boonville, which lies to the east and north of Black river.

We have said that the northern side of the valley of the Mohawk, is in general formed of the inclined planes of the surfaces of these rocks; the exceptions being caused by local or partial uplifts, which have deranged the surface and destroyed that continuity of strata and rock, and created to the casual observer, where the uplifts exist, the greatest apparent confusion as to their superposition or order of arrangement.

Uplifts.

Along the borders of the Mohawk, from the eastern end of Montgomery to the eastern part of Oneida county, there exists a series of parallel uplifts, extending but a short distance south of the river; their effect in that direction, being confined altogether to the valley, the visible action having ceased before reaching that great massive, the southern boundary of the valley, which no local action of uplift has disturbed.

Northwardly the uplifts extend for some distance, but are finally lost in the mass of primary rock, of which gneiss, the lowest member of the uplift, seems to form the greater part. These uplifts, therefore, are parts, or what would be called projections or spurs of the great primary mass, which forms the high grounds and lofty elevations occurring between the valley of the Mohawk and the St. Lawrence.

The general direction of the uplifts, that is the greatest length of the masses or rocks which compose them, is north and south, as is evidenced in the Noses and Little-Falls, the two most remarkable. The uplifts vary as to length, breadth and height. Some of them traverse the whole extent, whilst others are partial, occupying but limited areas. Whilst some exhibit the whole series of rocks which form the surface of Montgomery and Herkimer north of the river; others are composed only of the upper rocks. In no instance is the order of the arrangement of the uplifted rocks at all changed so gradual was the rise, and from facts to be mentioned in the final report, the uplifts must have taken place under water.

With few exceptions, the whole of the upliftings have been produced by an action from east to west, in accordance with the general character of the great uplifts of the globe, namely, the eastern sides rising murally, whilst the western sides slope off, becoming more or less horizontal. Thus in the valley of the Mohawk, the uplifts have invariably been thrust or protruded through the black shale, their eastern ends rising like a wall, whilst their western ends gradually slope off, and are lost in the same black shale, which, when the whole series is complete, forms the upper part of the uplifts, and lies by the side of the gneiss to the east, curving from a horizontal surface upwards to that rock.

These uplifts, which other facts conclusively prove, have been thrust through the black shale subsequent to the formation of an original valley, whose bottom was scooped from that rock, the rock extending from near Rome to the Hudson river.

It is to the uplifts that the apparent confusion which exists in the geology of the counties of Montgomery, Herkimer, and part of Oneida, is owing. But for these uplifts the primary rock and the black shale would form the surface rocks of the northern parts of the two first named counties.

Amongst the phenomena which these uplifts have given rise to, is the small lead mine on East-Canada creek, noticed by Mr. Conrad in his report of last year; also the production of a small quantity of ochery iron ore in others, at their mural ends, as at Little-Falls.

These uplifts of the Mohawk, from their limited extent, from no derangement accompanying them, other than what is most obviously intelligible; from their well defined configuration, and from being one of the terminal or extreme western limits of those great derangements whose cause has acted with so much violence along the whole of the Atlantic region of the United States, and from a number of highly interesting phenomena, are admirably calculated to instruct the student of geology in the knowledge of some of the proximate causes of the varied appearance of the surface of the earth and the derangement of its strata. Here, too, they form laboratories for knowledge, and not manufactories of mineral wealth, as we find they do in similar but more extensive, though more obscure, positions further south.

It may be supposed that in thus treating the subject I have trespassed beyond the bounds of the annual reports, but so necessary is the knowledge of these uplifts to show the cause of the derangement of the surface of the counties where they exist for practical purposes, that had they no other foundation than was required for illustration they were admissible; but as matter of fact and matter of utility their omission would have been inadmissible.

MONTGOMERY COUNTY.

The whole area of this county, with perhaps a small portion to the southwest, which I had not time to examine, lies to the north of the great elevation, and therefore contains a less number of rocks than the counties of the west through which the great elevation extends. Gneiss, calciferous sandrock, birdseye, Trenton limestone, black shale and the rubblestone of Prof. Eaton, with green shale in small quantity, were the only rocks met with in Montgomery county.

The order of the arrangement of these rocks is invariably the same. There may be exceptions to the casual observer, but the exceptions are merely apparent, arising from the uplift, by which a lower rock is placed upon the same horizontal parallel with an upper one, but when the rocks of the uplift are examined, they invariably show the same series in the order enumerated, though often one or more of the upper members are wanting, owing to denuding action, of which other facts bear ample evidence, no part of the third district yet examined, having been exempted from destructive agents, especially the erosive action of water.

The rubblestone, with its green shale, occupies the whole of the southern border of the county, being the upper rock. When fresh quarried, it is of a blueish green colour, but becomes of an olive by long exposure to the air. It appears to stand weathering, for all the numerous enclosures met with in that part of the county are formed of this rock, its fragments being very numerous, extending not only over the surface of its own area, but over the black shale in part likewise.

The black shale appears from under the rubblestone, and like it extends east and west throughout the county. In advancing towards the river, its surface of continuity is broken by the uplifts, of which three well defined and broad ranges extend over the river. Before the black shale reaches its northern limits, it meets with similar interruptions, as at Frenchman's creek, Claus patent, Ephratah, &c., these are but of small extent, and finally disappears by the side of one of the three upper rocks of the uplifts, though its more common termination or boundary, is the unsettled region of the gneiss, the junction being frequently obscured by the alluvial of its border. The northern point of the black shale, on the east side of the county, is a mile or two beyond Mayfield corners; and on East-Canada creek, it terminates about a mile above Little Sprite creek; a slight curved line to the south, connects the two points, or in other words, forms its northern boundary. Near Mayfield corners, where the shale occurs, it was supposed to be plaster, and a mill was erected to grind it.

By decomposition, the black shale produces a dark coloured tenaceous soil, highly favorable for grass. It is to this rock that Montgomery owes its best soil.

The Trenton limestone, the birdseye and the calciferous sand rock being placed above the gneiss, the surface rock north, and below the black shale, the surface rock south, appear in all their different localities, excepting, probably, in a few places near the unsettled parts north, as rocks of uplift or protrusion through the black shale. Along the Mohawk there are three great ranges of uplifts within the limits of the county that cross the river. One of them, well known by the fancied appellation of the Noses, exhibits the whole series, from the gneiss upwards. This is the most extensive as to length, to height and regularity of these disturbing elevations. The two others commence with the calciferous as the basis rock, exhibiting the upper rock likewise. These two uplifts occur on opposite sides of the county. The one to the east, forming the range upon which Amsterdam is placed; the other to the west, extending on both sides of St. Johnsville. Besides these general, there are along the river some minor ones, as Tribes-Hill, where an interesting series of low hills are cut through by the rail-road, exposing as usual, the calciferous to the east, the birdseye, Trenton and black shale to the west, each following in its regular order. Another small uplift occurs at the small creek to the east of Fonda; this shows the

Trenton limestone only. The third and last is at Fort-Plain, and one, too, of great interest.

Why we have been so particular in giving these details, is from the circumstance that all the quarries along the Mohawk, either for lime or building stone, owe their origin to these uplifts, and since the great and extensive public works have commenced, giving impetus to private improvement of all kinds, the importance and great value of these quarries is fully appreciated by every one connected with them. Moreover, when the present quarries are exhausted, knowing the uplifts, the order of arrangement of the rocks which compose them, the direction of the dip or inclination of the layers, all which knowledge is readily attained by examination, the discovery of others will be attended with no difficulty.

The birdseye is the principal rock which is quarried for the public works, though the lower layers of the Trenton, especially near Amsterdam, are likewise used; there they occur much thicker than observed in any other part of the third district, excepting the upper layers of the same rock in Oneida, called in the report of Mr. Conrad, the gray crinoidal limestone, that part of the Trenton limestone not being found either in Montgomery or Herkimer county. The principal quarries and localities of the birdseye limestone are at Helmicks, Canadas and Klocks, on and near Crumb creek, Palatine church, Ephratah, Fort-Plain, Flat creek, Tribe's-Hill, Amsterdam, on both sides of the river, near Evaskill, Marcellus quarry, between the kill and Chucteronde creek, and at Peter Fonda's, in Claus patent, town of Mayfield.

At the quarry of Palatine church, the best preserved fucoides demissus or stylastrites of Prof. Eaton are to be found. This is the fossil which characterises the birdseye. Whilst the fucoides in all the other rocks are disposed parallel to the layers, these are vertical, as though in the position in which they grew, a circumstance not confined to one place or locality, but almost invariably common to them all.

Calciferous Sandrock.—Few rocks of the third district present so many features of general interest as this rock. Like most sedementary ones, it is in well defined layers, easily quarried, of the required thickness for ordinary masonry, and undergoes little change by exposure to the air. This rock is very variable in character and composition, as well in different parts of its mass as in different localities. In general, as its name signifies, it is composed of carbonate of lime and sand, in no fixed proportion, varying so greatly as often to be wanting in one of its components. This circumstance is common, for example, to the lower layers; these layers being more compact, hard, and not so regular in their outline, the lines of separation not being parallel, but waved and irregular, as though they had been unequally compressed, owing, no doubt, to the removal of their carbonate of lime, and the partial solution of their silicious material.

With these layers, we often find coarse agate flint, silicious concretions and those round or ovoid bodies, also of silex, called oolite.—These various productions, with a number of other circumstances, prove that the materials of these layers had been subjected subsequently to their deposition, to a mechanical motion as well as a chemical action.

Upon these layers, in many localities, there are others abounding in cavities, containing rock crystals and anthracite coal; the discovery, or presence of the latter, having excited in many localities no small expectation of realizing by excavation, important beds of this material. The coal is often enveloped by the crystals, and often presents those appearances common to viscous substances which have been in a fluid state. Above these layers, for example, in Flat creek, near Spraker's basin, where the whole series may be seen to the greatest advantage, there are thin layers containing the impressions of imperfect fucoides or marine plants, the only common fossil of this rock. These plants, in all probability, were the source of the coaly matter, the separation of the carbonaceous material having been effected by the action of thermal waters; the cause likewise of the product enumerated, as well as of other highly important phenomena, but which properly belong to subsequent rocks. Of the innumerable ancient localities where this subterrene action, as it may be called, has manifested itself, few only now exist in the United States, whose waters reach the surface. One in Buncombe county, North Carolina, another in Virginia, the third in the valley of the Hoosick, and the last in Arkansas. The first locality, from my observations, exists in a depression, by the side of which is the calciferous sand rock. Opposite to the springs of hot water, the layers of the rock are very irregular, more or less vertical, of a whitish colour, but at a little distance to the west, they present their blue colour, common to this rock where lime is in excess and their well defined parallel lines of separation dipping to the east. The calciferous, with the primary rocks to the east, form a synclinal line, a circumstance common to the hot springs of Virginia, as we find in the report of Prof. Rogers of that State, and no doubt common to the others likewise.

Though we have no proof that all these hot springs originated in the lower part of the calciferous, attention in that point of view not having been directed to them, yet I have no doubt of their common origin in this rock, finding no fact in opposition, and knowing that this rock in the United States, is the most ancient and most extensive, of all those which rest unconformably upon the primary mass. The effect of this difference of position is this, that whatever derangement the primary mass may receive, is not always communicated to the other; hence separations or caverns may be created between their surfaces, into which surface water may find its way, and thus be subjected to the temperature incident to great depressions.

Along the Mohawk, the calciferous sand rock appears at the uplift of Amsterdam, extending on both sides of the river, and to Crane's village to the east, where our observations ended, and as far north as Hagaman's mill. The next locality is Tribes Hill, the Noses, Fort Plain, and in the neighborhood of St. Johnsville, on both sides of the river. North of the Mohawk, it appears at the Fish House, in two localities in Mayfield, in the vicinity of Lacellsville and in several places between that village and East Canada creek, these latter no doubt forming a part of he broad and irregular uplift of St. Johnsville.

The calciferous sand rock appears to contain more carbonate of lime in its composition at Tribes Hill, and in the small streams between Amsterdam and Crane's village, than on the western side of Montgomery county, and appears to contain still less in Herkimer county. In no part of the third district is this rock found as a pure limestone, or without silicious matter in its composition. This is very different from what is known of this rock in other States. Thus in many parts of New-Jersey, Pennsylvania, Maryland, Virginia and North Carolina, it makes excellent lime by burning, and ranks amongst the limestone rocks.

The calciferous, though in a measure a metalliferous rock, is by no means a productive one, occupying, as it does, an extensive area in the United States, it furnishes, so far as my knowledge goes, but one mine, that of Austinville, in Virginia, which is of lead. This lead mine shows what observation in New-York proves, that its most abundant metallic mineral is pyrites, a fact which throws the greatest light, as will be shown, upon the origin of the extensive iron beds of Herkimer and Oneida, as well as the gypsum, all which occupy a higher geological level.

Gneiss.—South of its great range or area in Montgomery county, the gneiss is met with but in the range of the uplift of the Noses, and below or south of Lacellsville; at the former, it makes its appearance on both sides of the Mohawk, and also on the eastern side, north of the river, and near the top of the uplift, in a small cave, caused by the removal of the calciferous. Its greatest surface of exposition is on the turnpike road which leads to Johnstown from the river.

To the information already given of the gneiss, by Mr. Conrad, I have not much at present to add. This rock seems, in a great degree, to partake of that character of toughness and indestructibility, so common to all the primary mass west of the Atlantic range of red sandstone, so different from the mass of primary rock east of that range, the latter being crumbly and ready of decomposition. It is to this cause, to the paucity of lime in its composition, and the absence of vegetable and animal matter, much more than to elevation above the ocean, since in many places it lies below the settled region of limestone and black shale, that the primary mass contrasts so strongly with the transition class, as to population, depending as it does upon vegetation. In Montgomery, Herkimer, and Oneida, where the primary mass predominates, we find one general character impressed upon its surface, that of having but few inhabitants, and so well fixed are the limits of each, that it may in truth be said, that population and that class of rocks, are negatively characteristic of each other. The connection exhibited in these counties of rock and soil, furnishes another to the very many instances of the importance of a knowledge of geology, to the causes of the difference in the different parts of the surface of the earth, as to agriculture and its consequent population.

In the dip of the general disposition of the line of division or layers of the gneiss rock, which is to the east and north, we find a ready solution of the cause of its destruction at the Noses and Little-Falls. The ends of the layers being presented to the current, parts were readily torn up and washed away by the hold which they gave to the water, and time was given for their destruction; but had the dip been in the opposite direction, it is equally obvious that no effect of the kind could have taken place; the Noses and Little-Falls would have been barriers to the waters of the Mohawk to this day.

As yet, no great use is made of the gneiss. A curious variety of the striped kind is quarried in the neighborhood of Kingsborough, forming a part of the high range of primary which bounds the great depression in Mayfield. Beside this, in the same range, are numerous and beautiful varieties of the porphyritic, which, were they in more accessible situations, would find their admirers and use.

In the relative surface distribution of the rocks of Montgomery, it may be considered, that gneiss and black shale occupy rather more than two-thirds of the county, and in about equal proportions. The rubblestone is the next in amount, then the calciferous sandrock, the Trenton limestone, and lastly, the birdseye.

Alluvial.—From the greatness of the action of waters in remote periods, the alluvial is of great magnitude. Extensive ranges of sand hills skirt the region of primary rock in many parts, and the course of what appears to have been the outlet of elevated bodies of water. Along the borders of the Mohawk, and in the banks of innumerable other streams, clay, gravel and sand, often attain the height of an hundred or more feet. So great has been the cause of alluvial product, and so numerous are the localities of the product, as well in the other counties examined as in Montgomery, that to enumerate the respective localities of clay for pottery and bricks, gravel for road making, &c. &c. would cause this report to exceed all reasonable bounds, and therefore with more propriety will form material for the scientific detail of the final report of this district.

It is highly probable that the clays are all more or less of the fusible kind, from the abundance of carbonate of lime contained in those rocks which have been most exposed to the destructive agent. The infusible clays being formed of silex and alumine, the addition of lime or oxide of iron gives fusibility, the degree varying within certain limits with the quantity added of those materials.

The sand which borders the primary region is the purest, as might be supposed from the nature of the rocks which has given rise to it, and is suitable for glass making, cement, &c. whilst that of the Mohawk and its tributaries is usually much sullied by the influence of its dark coloured associates.

Of the Ores of Montgomery county.—In Flat-creek, south of the Mohawk, about one mile from Spraker's basin, consequently within the limit of the uplift of the Noses, lead ore for some time has been the subject of research. It is sought for in the black shale which at the mines forms the vertical sides and the bottom of the creek. From the rock being uncovered, an admirable opportunity is presented for the examination of the innumerable small veins or rather strings of lamellar carbonate of lime which are presented to view. The greater number of the veins are but a line or two in width; few only attain to the same number of inches. No determinate direction governs them. Some of the veins, besides the carbonate of lime, contain small particles of sulphuret of lead, or galena; others, pyrites, and in some rare instances, a little sulphuret of zinc, or blende.

The first workings met with in ascending the creek, at the time I was there, were the most promising; and should the excavation continue for about 15 or 20 feet in perpendicular depth, the Trenton limestone, which underlies the shale, will be reached, and then an opportunity will be afforded of knowing the influence which the rock containing the veins has upon the veins themselves.

Above these veins, on the same side of the creek, there is an interesting and beautiful cluster of veins, made up of pyrites chiefly, verifying the saying that "all is not gold that glitters." It was from amongst these veins that the large piece of lead ore, deposited, as we were informed, in the office of the Treasurer of the State, was taken. Beyond this working, on the opposite side of the creek, others were being made; but as I apprehend, like all the veins of this creek, as well as all others yet visited, will add more to knowledge than pecuniary profit.

The mine on East Canada creek, to which Mr. Conrad last year was denied admittance, was this year fully open to inspection. It owes its origin to one of the most interesting of the uplifts of the Mohawk valley, promising at no distant period to become one of the classic points of geology.

From the bridge over East Canada Creek, at Manheim village, the calciferous sandrock appears, forming the left ascending bank, also the falls of the creek; and on the right bank of the creek, at the foot of the falls, it rises perpendicularly, with the birdseye superimposed, the two rocks attaining the height of about 30 or more feet. On that side of the creek, the black shale comes up from the bridge, with the same small dip as the calciferous, namely to the southwest, and terminates abruptly, by a curve upwards, against the calciferous and birdseye, exhibiting the Trenton limestone beneath at its point of curvature. Thus we have on the same parallel, forming the opposing sides of the same creek, two very different and dissimilar rocks, as to age, composition, and fossil contents.

Few objects so local present so many points of attraction as the small mine which exists at the junction of the rocks. Whilst the calciferous, with the birdseye, preserve their common position, the shale rises in the space of a few rods, by a graceful unbroken curve, from an apparent horizontal to an almost vertical position. Between the two rocks, which at the height of 20 feet are not many inches apart, but which widen greatly in descending, there exists on the side of the calciferous a wedge shaped mass, more analogous at first sight to the wacke of the Germans, or volcanic tuffa of others, than to any other known aggregate. On examination, there are two varieties, one of an ash gray and granular in its parts, the other a dark dingy green, with green lamellar talc, resembling mica, sparingly disseminated. This latter variety has all the characters of an impure serpentine, some specimens of which, from having small veins of carbonate of lime passing through them, have the appearance of an incipient verd antique. The gray variety exhibits spots of green carbonate of copper.

It is between the wedge shaped mass and the black shale that the small vein is found of lamellar carbonate of lime with galena, the object of the German miners, as mentioned in my predecessor's report. So far as I was enabled to examine the vein, from the workings that had been made, and from facts elsewhere collected of the same rock near the Mohawk, I have no hesitation in asserting, that all further prosecution of this mine, though of great interest and probable advantage to science, will be of little profit to the miner.

I was informed that lead ore had been discovered on that part of Royal Hill in the town of Ephratah, not far from Garoga post-office. I examined the locality, and was satisfied that what lead had been discovered must have been in loose pieces, the rock containing none. The hill is composed of gneiss, with here and there, at the place in question, black lead, or plumbago, in small particles, disseminated like mica, throughout the rock. This was the only mineral excepting garnet found in the rock.

Royal Hill is one of those high, long, narrow, north and south ranges, which rise abruptly to the east from an alluvial valley; its immediate connection with the more modern rocks equally obscured on the southern and western sides by hills of sand, though the black shale on its south and eastern part is not remote from it. The northern part of the hill projects into and forms a part of the unsettled region of Montgomery. This and similar other hills, may prove to be important elements in the determination of the former state of all that part of the country which now makes a barrier between rocks of the same age, the one flanking the side towards the Mohawk, the other, according to my colleague, Professor Emmons, in his first report, towards the St. Lawrence and the Hudson.

HERKIMER COUNTY.

The same rocks which appear upon the surface of Montgomery county, likewise appear upon the surface of Herkimer county, and in the same general order.

The line which separates the primary rocks north, from the transition rocks south, commences a few miles north of Black creek, running parallel with that creek, extending east of Ives' tavern, curving south to Spruce creek, down which it follows to Salisbury Centre, passing east into Montgomery county. With the exception of Little-Falls, we find the whole of the primary, north of this line, extending through the wild and unsettled parts of the county.

Uplifts and denudations have varied the surface, though not to the same extent as in Montgomery. The uplifts being confined to the range of the Little-Falls, to East Canada and to West Canada creeks, the effect of the latter one, being visible for many miles along its course, Middleville probably being near the point at which the calciferous sandrock, the lowest rock of this uplift, attains its greatest elevation. The hard silicious layers whose surface undulates, and whose sides have lost their parallelism, occur on the creek below that village; and at Middleville we have the local, where rock, or quartz crystals, and anthracite coal are most abundant; the latter, however, not in quantity more than required for cabinet specimens. No locality, probably, in the world, produces more numerous, perfect, or more beautiful rock crystals, than Middleville; with an equal refractive power, they would more than rival the diamond.

The calciferous, the birdseye and the Trenton limestone are not abundant as surface rocks; they appear in all the uplifts mentioned, and in the depressions below the black shale, such as are met with on the southwest side of Spruce creek, Black creek, and some of the tributaries of West Canada creek.

The birdseye is extensively quarried for the State on the south side of the Mohawk, above Little-Falls, and at Snell's quarry, on East Canada creek, about a mile or two above the river. This rock, for the work for which it is intended, has no superior.

The greater part of the county between the primary mass north, and the Mohawk south, is covered with black shale; the chief cause of the favorableness of that part of the county for dairy farming, the shale producing by decomposition a highly favorable if not the best of grass soil. To this advantage, there is added a fine southern slope, and that moderate temperature in the summer season, which is required for first rate dairies, as to quality, either of cheese or butter.

South of the Mohawk from Oneida county, the black shale extends along the course of the river, interrupted by the uplift of Little-Falls, over which, at the southern end, it passes, and connects itself with the mass below, through which the uplift had been protruded. From thence it continues along the river, meeting but one more uplift near the county line, the prolongation of the East Canada.

The black shale, both north and south of the Mohawk, is usually accompanied by thin layers of very impure compact limestone, in which it differs from the next mass which succeeds to it, the green shale which has, on the contrary, thin layers of sandstone or rubblestone, the same rock which covers the black shale to the south of Montgomery county. There two shales form the surface which lies between the river and the elevation which bounds the valley to the south, though the greater part of both is covered with alluvial.

Millstone Grit of Professor Eaton.—Immediately on the green shale, without any connection other than support, reposes this quartz conglomerate, a rock of some interest, being the first one met with made up of rolled stones or pebbles. They are of vitrous quartz. This rock extends throughout Herkimer and Oneida, with a thickness of thirty or more feet. As this rock was not laid down in any of the common systems of geology, it was considered by Prof. Eaton as identical with a similar rock, as to composition, forming a member of the coal series, and called by the English geologists the millstone grit. From the brine springs of New-York being above this quartz conglomerate, and the position of many of the important salines of Europe being above the coal of that continent, that of Cheshire being a noted instance, gave rise to a coincidence in analogy which readily identified them.

The lower part of the conglomerate is almost invariably highly charged with sulphuret of iron or pyrites, the part containing it usually from five to six inches in thickness. By the action of the air, the pyrites is changed to copperas. In some localities, where the shale has undergone decomposition simultaneously with the change in the pyrites, both copperas and alum are formed. In no locality, however, did I find a sufficiency of either to be an object of profit. This rock is not used in Herkimer, but a small portion only of its surface being exposed, forming narrow and short terraces in the rise or side of the hill which forms the southern boundary of the valley. In other positions, it shows its edges only; these are in the ravines or small water courses, which have cut through the strata in part, in descending from the hill or ridge, such as Steel and Frankfort creeks.

Resting on the millstone grit, a series of shales and sandstones are discovered, extremely diversified in composition, colour, thickness, contents or associates, meriting the name of a protean mass. This is the saliferous rock of Prof. Eaton, including the gray band. Organic remains, both vegetable and animal, are common; all which, like all those discovered in the lower rocks, are of marine origin.

The shale, when not altered, is usually of some shade of green; the sandstone green, red and white. The green sandstone commonly the lowest, the red the middle, and the white the upper part of the mass.

In this series of rocks commence those beds of red oxide of iron which have long been worked in Oneida county. The number of beds vary from local causes. In Herkimer they are from 1 to 2, in Oneida from 1 to 3, depending, as I fully satisfied myself, upon the nature of the surface over which the iron flowed. If the surface was permeable, the iron was absorbed by the mass colouring the rock. If, on the contrary, impermeable, a bed of ore was the result. The greater part of the ore is oolitic, resembling the roe of fish. The beds are from one to two feet in thickness. They are found in all the water courses, great and small which have cut through the mass, such as Fulmer creek, Steel creek and its branches, and Frankfort creek.

A hard white sandstone, the gray band of Professor Eaton, in Herkimer, terminates this group, an arrangement adopted from expediency merely. The white sandstone does not appear to be a continuous mass, excepting through the town of German-Flats, where it forms a narrow and interrupted terrace. Its thickness is about 70 feet. So far as I could judge at the time, it is in this sandstone, as it begins to lose its homogeniety at the west end of the town of Starke, that in mining for a supposed silver ore on the farm of James Crill, gypsum or plaster was discovered.

The gypsum was met with when about half way from the entrance of the adit, forming an irregular though roundish mass, its longer axis at right angles to the adit. The gypsum being very different in its appearance from the lake plaster, Mr. Crill, when I first visited the adit in the spring, was doubtful of its nature and its quality. Having satisfied him on both points, and advising the search for more at right angles to the adit, I found, on a re-visit in the fall, that from 20 to 30 tons had been obtained.

The gypsum is very white, and is equal to the Nova-Scotia, both before and after calcination. I mention the latter circumstance in consequence of Mr. C. informing me that he had been told that it became yellow by heat, which I did not believe, and which experiment, for the information of those concerned, shows to be false. Those who have a knowledge of gypsum well know, that in a crystalline state, it has little tendency to mix, much less to unite chemically with colouring matter.

Amongst the products thrown out with the gypsum, were white and greenish sandstone, white sand, and the same kind of drab-coloured, indurated marl or shale, which encloses the gypsum of the outlet of Seneca lake, likewise enveloping small roundish or irregular masses of gypsum. Besides these lining the cavities in the sandstone, were crystals, probably of sulphate of strontian, of a whitish colour, and the same in their fibrous plates, of a blueish green colour, lying between the layers of the rock. Considerable deposit of hydrate of iron colours the water of the adit when agitated. Of the fossils discovered, they were such as characterized the group to which the sandstone belongs, but of a lower level.

The adit was dug in the side of a hill. The upper part of it, where other small excavations had been made, exhibited thin layers of impure water lime. Near the mine to the west of Mr. Crill's, there is a considerable deposit of tufa, much of it stained with yellow oxide of iron. The origin of the search for silver, which caused an adit of 430 feet in length to be excavated, and at a cost of about $3,000, is no bad exemplification of mining operations, commenced without appropriate or requisite knowledge. The ochery stainings of the calcareous tufa, the ferruginous waters, and above all the divining rod, first prompted to the working. With these fallible guides, another plausible one was soon added, the excavation furnishing from time to time a number of small cavities lined with crystals of sulphate of strontian. Such is the connection of metallic substances or ores with earthy or saline crystalline minerals, as mentioned in the first report, that the latter are known amongst miners by the familiar name of blossoms, supposing that the same analogy exists between ores and these minerals as exists between fruits and flowers, the presence of the latter indicating the presence of the former. Though metallic crystalline minerals are accompanied by one or more earthy or saline crystalline minerals, yet it by no means follows because we find the latter we shall discover the former, from the circumstance of earthy minerals being vastly more abundant than metallic ones.

The white sandstone of the group under consideration, is used as a building stone; so likewise is the red, part of the front of the Ontario Bank at Utica being formed of it.

Red Shale.—Above this group, and resting upon the white sandstone, as may be seen at Cruger's mill, and on the road to Cedarville, from Herkimer village, is the red shale, whose uniform deep red colour exhibiting no separations by well defined layers, its tendency to disintegrate in small angular gravellike fragments, which are readily resolved into earth, its great thickness, being at least 150 feet in this county, its containing no organic remains, requires it for the present to be separated from the group last described. There is nothing in the whole of the red shale to break its uniformity, excepting two thin layers of about two or three inches thick, much more hard and less liable to disintegration than the red shale. It makes a pretty good hone, and greatly resembles the ferriferous shale of Prof. Eaton, which forms a thick layer at Rochester. Besides these layers there are green spots, or nucleii, occasionally met with, and a hard greenish gray sandstone about two inches thick at Cruger's mill dam.

The red shale is connected with the next series above, namely, the water limestone. The red shale alternating with it. This is well seen in Frankfort creek, just below the upper saw-mill, and above Kellock's lime-kiln; in other localities also, but not so distinctly. The terrace which is formed of the red shale, is greater in all respects than any of the rocks below it, which form the hill side. Its chief interest consists in being the first of a series which exhibits alluvial deposits formed anterior to the excavation of the Mohawk valley.

Water Lime Series.—This differs greatly from the last mass in appearance; its layers, though rarely over two or three inches, are well defined, and in its uniform drab colour; but like the preceding rock, it is deficient in organic remains, not having found one in either. All the layers I have examined effervesce with acids, and though they are not all suitable for water cement, not being homogeneous as to the proportion of their constituents, yet I have no doubt some of them would afford a cement equal to any elsewhere made in its extensive range to the west.

In the limestone at the Falls of Niagara, and of numerous other places, and in some of the water limes below that limestone, there is at the separation of the layers a singular columnar appearance, presenting itself at right angles to the layers, extending unequally as to length, bearing no small resemblance to the sutures of the scull. When examined they show the impress of a parallel fibrous or striated appearance, which is almost invariably covered with minute scales of coaly matter. In vain I sought last year for the cause of this common appearance. In examining the upper layers of the water lime in Herkimer, the difficulty was solved: specimens were discovered with the striœ, and with carbonate of lime in minute fibres as to thickness, but not in length, clearly proving that the phenomena in question was caused by the crystallization of a saline substance in fibrous crystals at the joints of the rock, analagous to those beautiful productions which all are familiar with, namely, the congelation or crystallization of water in loose and spongy soils. This explanation meets its confirmation in a specimen recently examined, which I brought last year from the Falls of Niagara, in which the striated appearance is finely exhibited, the specimen being exceeding fresh and unaltered; on the top of the black or carbonaceous coating there are two small groups of fibrous sulphate of magnesia, which the force of crystallization has ejected since being in the cabinet, to the height of a quarter of an inch, and for want of a support the ends coil over, as we find in the black part of the banks of our ditches and other low grounds.

From finding last year the sulphate of magnesia with common salt as an efflorescence, below the upper falls at Rochester, and knowing that the fibrous form is the most common crystalline appearance of Epsom salts, I am disposed to believe that this mineral is the parent of the pheomenon in question, the cause of which has been no small perplexity to others as well as to myself.

The carbon which invests the striœ was a subsequent action, probably a deposition from the same water which dissolved the mineral, analagous facts being familiar to chemists.

It is from the water limestone, and from the limestone which rests upon it, that the calcareous tufa, which is found in every valley or ravine that extends to the water limestone, owes its origin. These deposits of tufa, when practical attention shall be given by the farmers to the improvement of soil by the use of lime, will, from their great abundance, purity and ease of access, have that value given to them which they justly merit.

On Frankfort creek, above the upper furnace, there is a deposite of tufa in hard or tough, though in thin layers. It is burnt for lime and carried to Utica. It makes the whitest lime I have yet seen in the State.

Upper Limestone.—The last of the series but one of the rocks of Herkimer county, is the upper limestone, embracing the cornitiferous, the geodiferous and the calciferous masses of Prof. Eaton; distinctions highly characteristic to the western part of New-York, but of no application in this; the fossils, relative position and general composition, being the primary characters. In the abundance and great variety of lapideous fossils, such as sea shells, corallines and crinoidea, we are presented with a character which strongly contrasts with the water limestone, the red shale, or any of the lower masses, with the exception of the Trenton limestone and the shales of Salmon river. In this limestone there is a more determinate arrangement of the different fossils, a creation as it were by families, than is to be found in any of the preceding rocks. Thus different species occupy different layers, each in countless myriads, and extending over a considerable extent of country. A whole race, seeming to be limited to a few contiguous layers, disappearing with those layers; to these other fossils succeeded, they in their turn giving place to a new creation, and for many repetitions during the deposition of this rock.

The limestone forms the surface of the southern part of Herkimer county, extending from its irregular boundary line into some parts of Otsego. It is from six to eight miles wide, forming a part of the great range of limestone which extends from Niagara river to the Hudson unbroken, excepting by the action of water, of which, with some exceptions, it forms the great dividing line between the Delaware and the Susquehanna to the south, and the Mohawk and Lake Ontario to the north.

The limestone is quarried in many places for building stone and for making lime.

Pyritiferous Rock.—This rock covers and conceals the limestone to the south of the county. It is the terminal mass north of the lowest of the series of the shales and sandstone of the southern counties. In no part of either Herkimer or Oneida, does this rock form a continuous mass east and west, being cut down to the limestone by the streams which flow south, dividing it into ranges, the intervals being filled with deep deposits of alluvial.

Metallic minerals or ores are rare in all that part of Herkimer county, which we examined. On the farm of Josiah Rice, about two miles from Salisbury corners, diggings have been made in the calciferous sandrock, which have furnished small quantities or specimens of sulphuret of lead, zinc, iron and copper, also stains of green carbonate of copper and bog ore, derived from the decomposition of the pyrites. There is no appearance of veins, but strings or little bunches appearing and disappearing without any regularity. Most of these ores, with coal and rock crystals, are found near the village; the same locality noticed in the survey of the Erie canal.

East of Salisbury Corners, distant about three miles, and in the region of the primary mass, an aggregate of granular carbonate of lime, and that variety of amphibole called coccolite, is found. It was blasted for marble. It is beautiful from the contrast of the green and white of its constituents, but does not show signs of abundance. It is on the land which formerly belonged to Col. Drake.

ONEIDA COUNTY.

The northern edge of the millstone grit corresponds very nearly with a line extending through the villages of New-Hartford and Vernon Centre. It shows itself in the water courses to the east of Utica, near New-Hartford in many places, south of Hampton village, also at Oneida springs, and the stone pound near Stony creek to the north and west of Verona.

By the lines of separation in the layers of this rock being more or less angular, and from similar kinds of markings on other parts of this rock, we have proof that the waters which deposited this mass were subjected to various movements.

The locks and other masonry of the Chenango canal near New-Hartford are formed of this rock. It is there in part stained with iron from the alteration of the pyrites, which is not common to this rock, excepting as mentioned before, in the lowest part of its lowest layer. It presents likewise a few of the large imperfect fucoides, and no other fossil.

The grit, from its solidity, exhibiting no tendency to alter by exposure to the air, would be greatly used, were it not for the abundance of superior limestones which the uplifts to the east have rendered so accessible along the banks of the Mohawk.

In a practical point of view, this rock in Oneida county forms an important line of division in the description of the rocks which occur to the north and to the south of it, dipping as the rocks do to the south and west. From the millstone grit to Lewis county, and between Herkimer county and the eastern boundaries of the towns of Camden and Florence, the whole area within these limits is covered with rocks, which are older than the grit, all of them passing under that rock. These rocks are first, the shales and the green sandstone of the lower part of Salmon river, and of the quarries to the south of Rome; then the black shale, the Trenton limestone, the birdseye, the calciferous sandrock and the gneiss.

The whole of the gneiss, or primary mass, is limited to that part of the area which lies to the east of Steuben, and the course of the Black river, in no place extending beyond the margin of the river. The calciferous and the birdseye are likewise restricted to the same limits.

Gneiss and granite form the bed and the side of Black river at Smith's mill, also at Hawkins' mill, a few miles below. The calciferous was not met with, not having extended our examination into the unsettled portions, for reasons previously given. The birdseye forms the bed and the sides of Black river, at Wheeler's mill, about two and a half miles from the village of Boonville. It is in layers of several feet thick, divided by the action of water into large angular blocks, the water having penetrated the original cracks and wore away the sides, so as to cause in some instances a separation of several feet. The erosive action of the water has not been confined to the sides; portions of the lower layers have been removed, deranging the upper ones. The effect of the action of water is exhibited in a more remarkable manner in Dry Moose river, whose outlet is about a mile below Wheeler's mill. The whole of the bed, which is of the birdseye for the distance of a mile or more, presents the same appearance as at the mill, the water in ordinary times finding its way through the separations below the surface of its bed: hence its name. This effect belongs only to rocks whose materials are soluble in water; and limestone and gypsum are the only two possessed of this property. Though not of equal quality with the birdseye of the Mohawk, from a greater admixture of black shale, yet, showing no marks of alteration by exposure to the air, this rock will be an important material for the masonry of the Black river canal, which will pass not far from it.

The gneiss, the calciferous, and the birdseye, being wholly confined to the town of Remsen and the Black river, leaves an extensive area for the Trenton limestone, and the black shale and the shales and sandstone of the lower part of Salmon river.

Owing to the depth of alluvial, and the flatness of the country between Utica and Rome, the boundary between these two last groups was not fully ascertained. In all probability it follows near the line of the canal from Utica, curving east of Rome towards Delta, thence pursuing a north course to Lewis county. East and north of this line, is occupied entirely by the black shale and Trenton limestone; this latter rock every where separated from the green and the black shale.

Within the area to which we have circumscribed the black shale and the Trenton limestone, we find the latter rock, which forms but a small portion of the surface, at a lower level than the black shale, with a few exceptions, arising from uplifts which extended into Oneida, altering the relative bed of the two rocks, as to collateral masses.

The limestone is found along the course of Beaver Meadow creek to its mouth; in Steuben creek, and some of its tributaries; in the bed of the Mohawk, below Lansing's kill. It forms the two great falls of Lansing's kill; extending from the upper one, to near Boonville village, near Holland patent and Stitsville; also, along the course of Cincinnati creek, and of West Canada creek, forming Trenton falls, from whence it derives its name; and, finally, from Cincinnati creek it covers the whole of the narrow space comprised between the road to the village of Boonville and Black river.

South of the Mohawk, the Trenton limestone, both in Herkimer and Montgomery counties, rarely exceeds a thickness of ten feet, nor much beyond that thickness in any part of the latter county. In Herkimer, between Fairfield and Middleville, (where it was quarried with the Birdseye, for the building of the college and academy of the former village,) as well, also, at Stony brook, below Middleville, the limestone attains the thickness of more than thirty feet. At Trenton falls, the thickness is upwards of 100 feet, and at the falls on Lansing's kill, the common estimate of 75 for the one, and 50 for the other, the inclination of the bed of the kill and rock being the same, gives a thickness of 125 feet. These facts show, that this rock increases in thickness in the direction of a line from Little-Falls to Lansing's kill, the confirmation of which is found along the road from Trenton village to Boonville, a greater thickness being there exhibited, than is common elsewhere to this rock.

It is only in Oneida county that the Trenton limestone exhibits two distinct masses, as to colour and texture, the dark or black coloured, almost compact limestone, and the light gray or sparry limestone. The latter, in thicker layers, appears to be made up of the remains of crinoidea. Other fossils are found in it, and such as are common to both masses, as leptœna, deltoidea, and delthyrus microptera. The gray limestone, commences on the Nine Mile creek below Stitsville, and extends north to near Boonville village. It forms the upper mass of Trenton falls. It is quarried near Holland patent, on Cincinnati creek, near where its waters are lost by sinking between the cracks or fissures of the limestone, and at Wm. Roberts's on a branch of Steuben creek. At these two last localities, it is worked for marble. Mr. Roberts uses machinery for sawing the stone.

From the gray limestone being in thick layers, of the required hardness, not altering by exposure to the air, and from proximity, it will no doubt be selected for the locks of the Black river canal, which will pass near Rome.

The value of the dark coloured limestone, is greatly diminished for the arts, by its almost constant alternation with the black shale. In some places this is so frequent, as at Trenton falls for example, that more than a hundred layers of each can be enumerated. This alternation shows a periodicity for the deposition of each layer, and a different source for the materials of each layer.

No doubt the time will arrive, when we shall seek in our own resources for those things which we now obtain elsewhere. When this period arrives, the Trenton limestone will furnish rare and beautiful black marbles, their interest increased from the abundance of animal remains, whose living prototypes have long ceased to find a place on earth.

It is only on the road, and not far from Remsen village, and above the falls of Lansing's kill, that any signs of ore were observed in this rock. These were stains of iron, derived, no doubt, from the pyrites of the decomposed black shale, interposed between the layers, forming an ochery soil.

In an agricultural point of view, the admixtures of shale with the limestone, have been highly favorable, in rendering the limestone more accessible to destructive agents, thereby more largely contributing to the forming of soil and furnishing a better one, than either alone.

The shales and sandstone of the lower part of Salmon river, cover all that part of Oneida county, which lies between Lewis county north, the millstone grit south, the black shale east, and a curved line which passes west of Taberg village, through the eastern end of Florence. Though it is exceedingly probable, that the high ground on the north-eastern side of Florence, is occupied by the green and red sandstone, the next rocks, which, always north of a line, passing by the northern side of Oneida lake, succeed or follow the shales, whilst the millstone grit south of that line, as invariably follow the same shales, showing that the grit thins out and disappears in a northerly direction.

The shales and their sandstone north of the canal are not much quarried. Their fragments are very common in many parts of this area, not covered by alluvial, and form the common enclosures of the country. But to the south of the canal, near Rome, there are several quarries, as Whitall's, Talcott's and Woodruff. The two latter are in thicker and more irregular layers of a light grayish green. They form the upper or newest part of the mass. Besides building stone, Mr. Woodruff's quarry furnishes grindstones. As is frequently the case, the mixture of shales and sandstone contains pyrites; this is exemplified in some of the stones of these quarries, showing some iron stains by exposure to the air.

The mineral spring at Hampton village, is in the shale. This spring is the result of a boring for coal, which was undertaken by Mr. Halleck, of Hampton, at the suggestion, some years ago, of an English miner. After going 106 feet, water rose above the surface, forming a perpetual fountain, which the owner has fitted up for visiters, wisely giving up all further search of the object which gave rise to it. The spring is much visited. Its analysis was made by Dr. Noyes.

The same series of rocks which occurs in Herkimer county, above the millstone grit, extends through Oneida county, with no variation as to the order of the different groups, nor any great variation in the upper limestone, the water limestones and the red shale; but with some considerable variation in the " saliferous rock," or protean group, as might be supposed from what had been observed of that group in Herkimer county.

Great difference, however, exist in the extent of surface distribution, or in other words, exposure of the same rocks in the two counties, owing to extensive denudations in Oneida. The high east and west range or elevation in Herkimer, being broken down in part into north and south ridges, through which the waters of the Sauquoit, the Oriskany, the Shanadea, and Oneida creeks now flow. The rocks which, in Herkimer, expose but little surface, our knowledge of them being almost confined to those parts which form the sides of ravines and small creeks; in Oneida, on the contrary, present a breadth of a mile or more, and a length which extends from the ridge between the valley of the Sauquoit and Oriskany, to near the western end of the county.

The same diversified group, the saliferous rock and the gray band of the "survey of the Erie canal," holds the same position in Oneida, and extends throughout the county, with about the same, if not greater, thickness. It is in this mass, south of Utica, that the quarries of Messrs. Blackstone & Davis, Gaylord & Norton, are opened for the supply of the city and the enclosure of their farms. The quarries of the two former are in the lower part of the mass, consisting of thin beds of hard greenish sandstone, separated by a very thin bed of green shale. The surface of the sandstone is thickly covered with fucoides, of numerous and undescribed species, successive growths of these plants seeming to have been destroyed by the successive irruptions of mud, which gave rise to the green shale which covers them.

The same mass which is quarried at Davis's, is likewise quarried on Swift creek, near Rodgers's machine factory. In both quarries the upper bed is made up of white and black pebbles, of the size of a pea. The lower surface of the bed is perfectly straight, or horizontal, whilst the upper one is waved, furrowed or water worn, a fact amongst hundreds, which shews the fitful state of our planet at that period. In both quarries the same green shale which lies between the beds of sandstone forms a thick mass upon the pebbles.

The white sandstone, or the gray band of Prof. Eaton, appears to be wholly wanting in Oneida; nor does the red sandstone appear to occur west of Oriskany creek. The green sandstone is, however, more abundant, some of the layers containing a large proportion of carbonate of lime, being made up of encrinal remains, cemented by that mineral. In some quarries these remains are highly coloured with red oxide of iron. Quarries of this hard green sandstone are common in all the towns containing the iron.

The whole of the red oxide of iron of the county, of which there are three beds, belongs to the protean group. It is to denudation and to the hardness of the ore, and the sandstone which frequently accompanies it, in resisting destruction, that so extensive a surface is exposed. Numerous pits being opened in the towns of New-Hartford, Kirkland, Vernon, Westmoreland and Verona. This ore is invariably in concretions, either minute like fish roe, or the size of small grains of wheat, resembling the small elongated sugar plums, frequently containing the joints or disks of the encrinite, fragments of trimerus, and more rarely orthis. Very few specimens of the ore but contain small particles of pyrites, which, although the ore makes good iron, as I was generally informed, would make still better were it invariably roasted and exposed for some time to the air before smelting it. It is well known that by no degree of heat, or by any known flux or mixture, can iron be freed from sulphur; but if roasted, the sulphur, by exposure to the air, readily changes to sulphuric acid, which is readily expelled by heat, the acid being put into the state of vapour. The beds of ore are from twelve to twenty inches in thickness.

Throughout Oneida, above the iron ore beds, forming a part of the same group, there are from one to two layers, according to locality, of a peculiar rock, exhibiting a concretionary structure. It is composed principally of carbonate of lime and sand, frequently presenting either constituent in a crystalline state. These layers are found in Swift creek at Hart's mill, on a branch of the Oriskany, in the creeks at Skanandea and Vernon, and in the ravine back of Dr. Noyes' house, near Hamilton college. At this latter place galena and blende in small quantities have been found in it. The only locality of either mineral met with in the county.

Reposing upon the group described as in Herkimer, so in Oneida the red shale follows, with no variation other than with more numerous green spots; as, for instance, near the salt sulphur spring or well to the east of Vernon centre. To the red shale succeeds the immense series of water limestones and the upper limestone, equally if not more prolific of calcareous tufa than they are in Herkimer. The tufa is found on the sides of the ridges or slopes, and in the ravines and small streams which cut into the two rocks. A locality of the former kind, remarkable for its great extent, occurs between Ely's saw mill and the road from Clinton to Waterville.

If it be true, as a Pennsylvania farmer asserts, and I have no doubt of the fact, that the primary cause of the depopulation of every country upon the globe, has been a *worn out soil*, how greatly in after times will these calcareous materials be prized. Without lime no agriculture can be perpetual. It is not impossible that a considerable portion of the soil of the third district, from its newness and the quantity of calcareous matter originally belonging to it, does not at present require this mineral, but the time will come when it will be needed, and with its enlightened population will be used.

Reposing upon the limestone at Oriskany falls, or Casety hollow, there is a white sandstone not seen elsewhere in the two counties. From some fragments which I found last year to the west, it is the same rock which forms the locks at Lyons, as I was told. The sandstone is divided into two or three layers; the whole mass about twenty feet thick. Parts are very friable, readily crumbling into sand. It is used at the glass works at Vernon. The fossils of this rock are peculiar to it, being very large species of the genus orthis and delthyrus.

In the towns of Marshall, Sangerfield and Bridgewater, the pyritiferous rock appears to rest upon the limestone, the white sandstone not evident.

In many parts of Oneida, and in different rocks, coal has been sought for, and in every instance wholly ineffectually, as might be supposed from the information now possessed of these rocks. Every locality was visited, where diggings had been made, in order to ascertain what had given rise to them. In almost every instance they were in dark coloured shale. In some of them were small fissures, usually filled with lamillar limestone and coal, just sufficient of the latter to excite hope in those unaware of the geological remoteness of these rocks, from the true coal strata.

OSWEGO COUNTY.

The county of Oswego presents very little geological variety as to rocks. The whole of its area, exclusive of the part to the west of the outlet of Oneida lake and Oswego river, that part not yet having been examined, exhibits no other rock than the gray and the red sandstone, with the exception of the towns of Sandy Creek, Pulaski, and a part of Richland; these towns containing those rocks which have been designated by the name of the shales and sandstone of the lower part of Salmon river. The shales and sandstone lie under, or in other words, are the supporting mass of the gray and red sandstone, the red invariably the upper or the newest rock. The shales and its sandstone are perfectly identical with those which extend through Oneida, reposing upon the black shale, not only in super-position, but composition and fossils likewise, which are exceedingly remarkable from their abundance, and for the first time in the series we have many species of pterinea. All these fossils, though they occur in myriads, ceased in Oswego with this mass, neither the gray nor the red sandstone exhibiting one, that we could discover, nor any other organic remains than fucoides.

Both the red and gray sandstone in Oswego county, present very little variety; comparatively the red is more loose and less compact or hard than the green. Both these rocks appear to stand weathering. At the falls of Salmon river, which are composed of the green, there is little exhibition of decay. The same remark applies to both rocks at Oswego; so also of the red at Fulton, and of other localities.

In every locality where the red and gray sandstone come together, it is very evident from the green spots in the red, giving it a mottled appearance, and from other like characteristic markings at the junction of the two rocks, that the colour has been owing to the infiltration of iron, which has been arrested by the gray rock. Although originally one mass, yet in a practical point of view, it is highly expedient to separate them. From the red sandstone, admitting of percolation, it is not surprising that this rock should be the geological location of the brine springs to the west.

The surface distribution of the gray and red sandstone is as well defined as their colour, with the exception of a small strip of red sandstone, which commences about four miles above the village of Redfield, and pursues a northeast course through the town towards Lewis county. The whole of this rock is confined to the south and west of a line, which commences on Little river in Oneida county, passes northwest by Squire Parks' mill dam, thence near to Amboy Centre, and by a slightly curved line to Mexicoville and Butterfly post-office, and from the latter village it passes by an east and west line to Oswego. At this latter place the two rocks are finely exhibited, the green at a lower level upon the shore of the lake, on both sides of the outlet, the red upon the banks of the river.

Within the area of the red sandstone, two attempts were made at boring for salt water, one on the land of George G. Grizzle, in the town of Palermo. The digging and boring were about 10 feet in depth. The water yielded half a pound of salt to a gallon of water. The salt was described as having a sharper taste than common salt. No opinion of the water could be formed at the time I was there, in consequence of an adjoining brook overflowing it.

The other attempt at boring for salt was on the land of Mr. Kenyon, in the town of Hastings, at an old beaver dam. It was likewise soon discontinued.

In no part of Oswego were we able to discover the mill-stone grit as a solid rock or mass. We had reason to believe that it had existed near Cleaveland, from the prodigious number of large fragments or blocks which are found to the east of the village, on the high bank and in the bank and on the shore of the lake, as well, likewise, about a half mile from that place to the east, on the road to Rome. What seems to give probability to the idea, is the occurrence of a sulphur spring at each locality; nothing of the kind having been met with in all that part of Oswego, connected either with the red or the gray sandstone. The Oneida sulphur springs issue but a few rods to the south of the grit, and the spring near Remington's forge, not far from the village of Mohawk, in Herkimer, is immediately above the same rock. Another circumstance confirmatory of the opinion, is the progressive curving of the grit to the northwest from Utica, to the stone pound near Verona, the prolongation of which passes by the place in question. This curving to the north accords likewise with the outline of the lower rocks.

In no part of Oswego that we visited, did we find or could we hear of the red ore of Oneida and Herkimer having been discovered. Bog ore occurs near the lake in two localities. It is used at the High Furnace at Rotterdam, mixed with the red ore.

Oswego county may emphatically be said to have been the sport of waters. The result has been, the destruction of an immense extent of surface rock, particularly red sandstone. The effect of the action of water has been the accumulation of clay, sand, gravel, and their mixtures, so as to form the soil of almost the whole of the county, very little of the soil having been formed by the decomposition of the rock in place.

A summary of the rocks or groups of this report, in their order of succession, beginning with the lowest in the ascending order, &c.

Gneiss.—The lowest rock of the district, surface exceedingly uneven, full of elevations and depressions, as though water-worn. This fact is observable at all the uplifts where the rock is exposed.

"*Calciferous Sandrock.*"—Deposited long posterior to the gneiss, many series of rock which observation proves that elsewhere exist between the two rocks, are wanting. The calciferous, moreover, rests unconformably upon the gneiss; great discordancest exis in the parallelism of their lines of separation or division. In some localities, the lower layers show marks of chemical action, as mentioned in the report; in others, as at the paper-mill in Herkimer, they contain rolled stones of vitreous quartz. Fossils, other than fucoids of the largest species, are exceedingly rare. I found but two or three specimens; they were casts of small spiral univalves, too imperfect to admit of a knowledge of either species or genera; likewise, two fragments belonging to crustacea. All these specimens were found in an upper layer of the rock.

"*Birdseye Limestone.*"—This rock contains fragments of the calciferous at Marcellus' quarry, near Amsterdam. We find also at some other places, for instance the falls in Flat creek, parts of upper layers made up of rounded fragments of its own mass, cemented by a more light colored limestone.

The birdseye is highly characterized by the vertical stems of the fucoides demissus. Other fossils are rare; the one usually met with is the orthostoma communis and the orthocera duplex.

Trenton Limestone.—The bottom of the lower layer of this limestone, at the quarries west of Little-Falls, is in part made up of round and elongated fragments of the birdseye. Well formed pebbles of the same occur in the limestone at Tribes' Hill. Its fossils are exceedingly numerous. Of undescribed genera there were two collected, the Trocolites ammonis and the Phragmolites compressus, and one species of a new Orthis, the glabella. This limestone is readily distinguished from all the other rocks, by the numerous individuals of the Leptæna alternata, Delthyrus striatula, Orthoceras striatus, Bellerophon apertus, Favosites ——, Calymene blumenbachii, Cryptolythus tessellatus, Isotelus gigas and cyclops.

Black Shale.—Contains no fragment of any rock. It is remarkable for being the floor or surface through which the preceding rocks, at a comparatively recent period, have been thrust or protruded. Its common fossils are three small species of fucoides, the F. dentatus, F. sevia, and F. scalarius. Paradoxides beckii, Lingula ovata, and a compressed involute univalve, resembling the trocholithus ammonis of the Trenton limestone.

Green Shale and its Sandstone.—This group is variable in its characters, in different counties, appearing as a dark coloured sandstone in Montgomery, with but little shale. In Herkimer, as a green shale, with but little sandstone, and with the same characters in Oneida to near Rome, where another, but a small series of shales and sandstone are met with, which north and west in Oneida, are co-extensive with the lower mass. Fossils are rare in the lower one, the most common is the Crytolithus tessellatus, and the pentremites. In the upper mass, they are remarkably abundant as species and individuals, the most characteristic are the Pterinea's carinata, P. modiolaris, P. pholadis, Cyrtolites ornatus, Productus planulata and Pleurotomaria terebralis and Bellerophon striatulus. With these fossils there is the recurrence of the Delthyrus striatula of the Trenton limestone.

" *Millstone Grit.*"—All the preceding rocks are below this mass, all passing under it. This rock is the first mass of pebbles met with in the series. The pebbles are of glassy quartz, same with those met with in the calciferous, only more water worn. Nothing extraneous in this rock, but pyrites and a few large imperfect fucoides.

North of Wood creek and Oneida lake, the green and red sandstone follow the last described series, but south of the Mohawk, the grit follows that series, and upon the grit reposes the protean group. The gray and red sandstone, within the limits examined, presenting no well defined common character of union with the protean group, requires more extended observation west, to remove the ambiguity occasioned by the absence of the grit in Oswego.

Protean Group.—This mass is about two hundred feet in thickness, consists of green and blue shales, green, red and white sandstones, red oxide of iron, gypsum, &c. The red sandstone of Herkimer, shows that the iron has passed through the mass by infiltration; much of it presenting its grains of sand enveloped by minute crystals of oligiste or specular iron, the appearance which belongs to the red oxide, when in a crystalline state.

This group abounds in fucoides; many of the species are new; in none of them could the Harlani of Oswego at Fulton, of Medina, Rochester and Lockport be discovered. The characteristic crustacea is a trimerus, probably the delphinocephalus. Shells exist, but not common, themost abundant is a Leptœna, like the planulatus.

Red Shale.—Mass uniform as to composition and colour, with the exception of a few thin layers of green shale, and gray sandstone, and spots of green shale. No fossils.

Water Limes.—No fossils; layers thin, of a drab colour. I found in this series, one specimen of the form which common salt assumes in crystalyzing upon a liquid surface; they are extremely common on Nine Mile creek, in Onondaga. They are called by the French, marne en retraite. The water limes, and the limestone above it, have furnished all the calcareous tufa of Oneida and Herkimer.

Upper Limestone.—This mass forms the elevated plain, as it were, to the south of the Mohawk. This limestone is well characterized by its fossils. The species which have given rise to the greatest number of individuals, are Cytherina —— Leptœna depressa, Leptœna punctulifera, Orthis affinis, O. concentrica, O. resembling the hastata, Pentamerus knightii, Certocerus —— Cyathophyllum ceratites, Columaria alveolata, tentaculites, Asaphus micrurus and Calymene bufo.

White Sandstone.—Characterized by large species of Orthis and Delthyrus.

Pyritiferous Rock.—Dark coloured, coarse arenaceous shaly mass, rises in broad ridges upon the calcareous platform, the waters which flow north and south dividing upon this mass.

The products of all that part of the third district, examined, with some important exceptions, are more immediately connected with the first wants of man, those of agriculture, building, &c. and with his highest, those which subserve science, rather than with that kind of mineral wealth dependant upon mining, the object commonly supposed of the great utility of a geological survey.

Though the class to which the rocks of the district belong, has been for some time known to a few of our geologists, yet it is only within a few years, that we have been able definitely to connect them with the European series. Until about eight years since, when Mr. Murchison commenced the examination of a part of Wales, nothing was with certainty known in Europe, of a like series; and from the delay in the publication of his work, being yet in the press, we are led to infer that he has experienced no ordinary difficulty in restoring the rocks to their original order of arrangement. What little he has published, from time to time, has been just sufficient to excite our desire for more information, and to fully establish in our minds, the perfect identity as to the general causes which gave rise to similar, if not almost identical, productions, separated from each other by a distance of over 3,000 miles. What is there obscure, is, in the third district, evident, the derangement being but partial and of great importance to the elucidation of the districts to the east, where the same rocks exist, and with a derangement of strata probably like that of Wales.

Of the specimens illustrative of the geology of the third district, so far as the examination extended, there were thirteen boxes collected, all which are in the rooms of the Capitol assigned to the survey.

LARDNER VANUXEM, *State Geologist.*

SECOND ANNUAL REPORT

Of the Fourth Geological District of New-York, by James Hall.

To his Excellency William L. Marcy,
Governor of the State of New-York.

Sir:—Having, at the commencement of the last season, been honored by you with the charge of the 4th Geological district, I beg leave to submit the following

REPORT:

The 4th District now comprises the counties of Wayne, Monroe, Orleans, Niagara, Erie, Genesee, Livingston, Ontario, Yates, Seneca, Chemung, and part of Tompkins; "the dividing line being nearly north and south, formed by the east boundary of Wayne county, the eastern border of Cayuga lake; thence by Ithaca to the dividing line of Tioga and Chemung counties, and by that line to Pennsylvania."

Although a reconnoisance of a great portion of this district had been made by Mr. Vanuxem and Mr. Conrad, while it formed a part of each of their respective districts, still it was necessary to obtain some general knowledge of its Geological structure, from personal observation, before I commenced the detailed investigations of its scientific and economical geolgy.

The rocks of the 4th District, consist principally of series of limestones, shales and sandstones, each passing into the other by insensible gradations in some points, while in others the line of separation is distinctly marked. Each formation or stratum, is limited on the north by its outcrop, and on the south of the superposition of the next successive deposit, under which the former disappears. The extension of these formations in an east and west direction, is beyond the limits of this district.

Indurated marl and sandstone forms the limit on the north, succeeded by shales, argillaceous and compact limestones. The limestones, for the most part, occupy a position between the extreme northern boundary and the middle portions; these are succeeded by argillaceous limestones, or calcareous shales, occupying a considerable extent through the middle of the district. To these again, succeed a series of argillaceous shales and sandstones, which extend to the southern limit of the district. The calcareous shales of the middle portion lose their calcareous matter on going southward, and become the dark shales of the coal measures. Throughout the whole of this district, so far as examined, we find no anticlinal or synclinal lines; the strata having an uniform bearing, nearly east and west, and dipping to the southeast. Neither are there any evidences of a disturbing force in the line of bearing; the outcrop and elevation is very uniform, exhibiting only a gentle undulation, operating over a great extent of country. Several of these rocky strata have their outcrop along the great limestone ridge or terrace, which extends from Rochester westward, far beyond the Niagara river. Along this line of bearing, we shall be able finally to present a very instructive section, shewing the increase and decrease in thickness of the strata above the sandstone; the thinning out of others and their commencement at a distant point; the change in lithological character of the same stratum at distant points, and the merging of two distinct strata into one. This line of outcrop, distinctly marked for 70 or 80 miles, and less distinctly for thirty more, furnishes some of the most interesting phenomena, regarding lithological and paleontological changes.

That portion of the district occupied by the limestones and calcareous shales, including nearly the whole of the two northern ranges of counties is one of unrivalled fertility. No other portion of the State of equal extent, possesses the same agricultural advantages. The soil is underlaid by calcareous rocks, constantly affording a supply of a most essential ingredient, the value and importance of which, if rightly appreciated, would even now, by judicious application, greatly increase its productiveness. To these we may add the facilities of transportation and communication, limited on the north by Lake Ontario, and more southerly traversed by the Erie canal; still farther south by rail-roads, (completed and in progress,) affording along the line of each a market for the produce of the surrounding country. At many points we find durable and beautiful building stone; and along a line of twenty or thirty miles a stratum of rich iron ore. The southern part of the district, or that occupied by the slates and sandstones, is less fertile; it affords abundance of pine timber, and possesses great advantages of water power; the soil is almost destitute of calcareous matter, which, with other circumstances, precludes the cultivation of grain; but on this account it is more desirable for pasture land. The Genesee and Alleghany rivers, together with Cayuga, Seneca and Erie lakes, furnish outlets for the transportation of the lumber from this part of the district.

Although it was distinctly stated in the reports of last year, that coal would not probably be found within the limits of the State of New-York, I found many persons who still believed in its existence among the bituminous shales of the middle and southern range of counties. In some places openings had been made where thin seams or detached particles of bituminous coal were found. Notwithstanding the numerous and decided failures in those undertakings, the belief still prevails that coal exists somewhere in the neighborhood of these shales, and that if enterprise could be rightly directed the object would be attained.

To those unacquainted with the true character of the coal formation and the relative position of these rocks, there are, indeed, some appearances that would indicate the presence of coal. Bituminous matter, or petroleum, is present in all, except the lowest rocks of the district,* and when we come to the shales above the mountain limestone, thin seams and disseminated particles of highly bituminous coal are of frequent occurrence. The escape of inflammable gas, and the odor of bitumen which accompanies most of the rocks, are considered as evidences of coal at no great depth below the surface, and under this erroneous impression the diggings or borings for coal have been undertaken. Although there is no necessary connection between coal and petroleum, yet the presence of this substance and the escape of inflammable gas from so many points in the different rocks is truly remarkable, when we consider that these rocks are so far below the slates and sandstones of the coal formation. It would appear that the causes which produced the bituminous character of the coal of Western Pennsylvania, were in operation at the time the lower rocks were deposited.

Whatever cause we please to assign for the production of this bituminous matter, we shall readily perceive that it is not essentially dependant upon coal, and that its presence in that mineral is rather accidental than otherwise. The presence or absence of bituminous matter as characterizing different ages or formations of coal, is worthy of little reliance. We here find rocks of great thickness and extent containing so much bituminous matter as to render its presence observable on percussion; and cavities are oftenfound filled with petroleum. Some of the shales contain so much of this substance that they will ignite; and yet all the fossil vegetables are a few species of Fucoides, the prevailing fossils in all these rocks being marine Testacea. The same rocks, too, that in our district are bituminous, in the eastern part of the State are entirely destitute of this substance; and in the latter place bear the same relation to the anthracite that the former do to the bituminous coal of Pennsylvania. I assert this from having carefully observed all the rocks, from the carboniferous or mountain limestone of the Helderbergh, (*not bituminous*,) to the anthracite coal mines of Carbondale, Wilkesbarre, Plymouth, &c. Pa.; and from the same limestone of Black-Rock, (highly bituminous,) tracing its connection with the coal of the northern counties of Pennsylvania. The fossil vegetables of the two coals are, many of them, identical, and if they were not it would be no argument in favor of different ages, for in the different or successive beds of anthracite, in the same neighborhood, we almost always find different species of ferns and other fossil plants.

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* The red marl and sandstone I have not found to be bituminous, though inflammable gas (carburetted hydrogen,) issues from the rocks of this formation in many places along the Erie canal, between Middleport and Gasport, Niagara county.

In general, each bed of coal is characterised by some species of fern, which prevails in that ore more abundantly than in any other. I feel confident that further examinations will prove the identity of the bituminous and anthracite coals, which, by some geologists, have been considered as distinct formations.*

From examinations made along the valley of the Genesee river from Lake Ontario to beyond the southern limit of the State, I have constructed a section showing at a glance the connection of the rocks of the 4th District, with the coal measures of Pennsylvania, and the improbability, if not impossibility of finding coal within the State of New-York.† In many places, and at the most interesting points along this line, we have natural sections of the rocks in the mural banks of the river, which at some points has worn its channel from 200 to 350 feet vertically into the rocky strata. These points afford some of the grandest views of rocks and scenery, and at the same time afford admirable facilities for geological investigation. In all cases where there are alternations of hard and soft, or shaly strata, we have fine natural sections along the river. Where there is a considerable extent of shaly strata, the banks are low and rise more gradually from the river. In such cases we can readily obtain a knowledge of the character and contents of the rock by tracing the small tributaries, which having less wearing force, commonly descend in a succession of rapids and cascades to the level of the river, thus affording ample opportunities for the most minute investigation.

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* Prof. Eaton, in his geological text book, published in 1832, suggested that the anthracite and bituminous coals were of the same age, but this appears to have been overlooked by those who have examined this formation.

† See section from the mouth of the Genesee river to Instantur, Pa.

I have already observed, that the direction or bearings of the rocky ranges is nearly east and west, and their dip to the south or southeast. The direction and amount of dip has been generally overlooked, or considered as unimportant, and for a short distance it may be scarcely perceptible, though it amounts to 50 or 60 feet in the mile, or about one degree. In some places the amount of dip is much greater for short distances.

I consider the rocks of the 4th District as belonging to the old red sandstone and the carboniferous groups, and to be above the Silurian system of Mr. Murchison. The evidence for this conclusion rests, in part, upon the organic remains, and if we can rely on these characters, there appears little question regarding the age and position of our rocks. The trilobite has never been found in any formation newer than the carboniferous, though it occurs in rocks much lower in the series. In our district the trilobites terminate with the rocks marked in the section as the shales of the carboniferous limestone. In the slates, sandstones and thin beds of limestone above this point, I have never seen a fragment of a trilobite.

The Calymene Blumenbachii, or Dudley trilobite, occurs abundantly in a dark blue limestone, somewhat resembling the mountain limestone, but below the red marl and sandstone represented in the section. That part of the marl and sandstone seen in the 4th District contains few fossils, except Fucoides, but the whole of the formation has not been examined.

In the shales above the sandstone we find several species of trilobites: The Calymene, macropthalma, C. bufo, C. Blumenbachii, Asaphus caudatus, Paradoxides Boltoni, Trimerus delphinocephalus.

The bituminous limestone and the gypseous rocks rarely contain trilobites, but the carboniferous limestone, and the associated shales contain several species, among which are the Calymene macropthalma or bufo, Asaphus, Crypheus, Dipleura.

There are other fossils which mark the distinction between the rocks, but none of them so characteristic as the trilobite. Our limits at the present time will not allow further discussion respecting the age and position of these rocks.

Above the shales of the mountain limestone we have (see section) a series of shales, grits, sandstones and conglomerates, with thin strata of limestone. These extend 80 miles, giving a thickness of 4,000 feet before we come to a bed of coal. The limestone shale, particularly the upper portions, contain nodules of bituminous limestone and septaria.

The accompanying map is an application of the principles of Isometrical projection to geological drawings. In this species of projection the limits of each formation may be defined, the character of the surface represented, the dip of the strata given, the natural sections, &c.*

The plan was conceived and the map constructed by Mr. E. N. Horsford, of the Rensselaer Institute.

Geology of the Genesee River.

From the mouth of the river to Carthage, three miles below Rochester, the red sandstone and indurated marl are the only rocks. The upper stratum of the red sandstone disappears beneath the river at the lower falls. Immediately above these rocks are the green shales, alternating with which are strata of limestone, and a single stratum of iron ore. Next in order of superposition, are the calcareous shales, alternating with thin strata of limestone, extending to the upper falls, and underlaying the Geodiferous and bituminous limestone. The lower layers of the limestone constitute the bed of the river at the upper falls. Near the feeder dam, scattered about upon the surface, are large angular fragments of the rocks in the vicinity.

Succeeding the limestone are the Gypseous slates and marls, extending as far south as Wheatland. A single view of a bed of gypsum is given in Wheatland on Allen's creek.

Upon the Gypseous rocks lies the mountain limestone, commencing at Caledonia and near West Mendon, and extending as far south as

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* Owing to a mistake of the engraver, the map is left without a margin, which essentially injures the effect.

Avon. Fragments of this rock are profusely scattered over the surface near Caledonia. Next in order succeed the limestone shales, extending south as far as Moscow. These shales are characterized by the vast quantity and beauty of the fossils found in them.

In the west branch of Beard's creek the septaria appear. An extensive section of the rocky strata at the entrance of the gorge near Mt. Morris dam, is given, embracing two layers of septaria. A few miles above the dam the alternations with the grits, or thin strata of sandstone first occur. The strata of sandstone are but few feet in thickness, and the predominance of the shales is manifest for a considerable distance up the river. The location of the Gardow slide is given, which took place about 12 years since. Above the slide the occurrence of the shales is less frequent, though the predominance of sandstone is not apparent below the lower falls of Portage. It was not intended to give all the angles and cliffs along this portion of the river, only such as are important and will tend to convey a general idea of the geology of this section of country. The accompanying section from Lake Ontario to Instantur, a town a few miles south of Smithport, Pennsylvania, exhibits the relative proportion of grits and shales.

The lower falls are 96 feet in height. The river, except in times of high water, is confined to the lower narrow channel given on the map. Between the lower and middle falls the perpendicular elevation of the rocky strata, in the highest point, is 351 feet. The middle falls, which are more generally visited, are 110 feet in height. The olive sandstone in the vicinity of the upper falls, is noted. Height of the upper falls 66 feet.

At Portage, the river enters the gorge, from which, after passing three successive falls, and for most of the distance descending with great rapidity, it passes into the Genesee valley, near Mt. Morris. It will be noticed that boulders are scattered about upon the surface with a degree of profusion below Mt. Morris. Above this point their occurrence is less frequent.

From Moscow, along the river to Rochester, very little evergreen timber is found, while in going south a small distance, as the subsoil is more and more composed of disintegrated sandstone, the pines and hemlocks, with their associates, are more frequent.

A few species of fossils occurring at the different localities, have their names respectively set to the right of the localities in the margin.

The design in the execution of this map has been to give a condensed view of the principal rock strata exposed along the Genesee river, and the streams flowing into it between Portage and its mouth. On a map so narrow, it was found impossible to observe that relative distance between points which on a topographical map would be required. Several views on the smaller streams, whose distance from the river is so great as to exclude them from a representation upon the map, have been brought in, as at West Mendon and the falls near Le Roy. And again, at York, Avon, Geneseo, and Mount Morris, the relative distances respectively have been greatly increased. But little regard has been given to any thing else than the exact order of succession in the rocks, as they are exposed in the views here given. This species of projection requires that the map be so viewed that the names of the rocks along the river will be read in their proper position.

The detailed examinations in the fourth district this season have been confined chiefly to the four counties bordering on Lake Ontario.

The rocks in these counties occur in the order in which they are described; the upper or gypseous rocks forming the southern boundary of each of the four counties. The description of each rock is distinct from the local and economical geology of the same, for the convenience of reference. Under the latter head will be discussed the economical value and utility of each rock and its contents.

SECTION I.

*Red Marl and Sandstone.**

This formation extends from tbe eastern boundary of Wayne county to the Niagara river, the limit of our district. Commencing at the Niagara river, where it is eight miles wide, it becomes gradually narrower, and towards the eastern part of Wayne county disappears beneath the lake; while at the eastern limit of this county it has again emerged, to the height of thirty or forty feet above the lake.

This rock in some places is extremely coarse grained and siliceous, and in others, for a limited extent, approaches a conglommerate. The siliceous portions are generally confined to a few of the upper strata, which alternate with seams of shale. The upper stratum of this rock has been called "grayband," by Professor Eaton; it, however, appears to be only a gray stratum of the sandstone, generally more siliceous and indestructible than the rock below. In some localities, however, the grayband is an indurated marl, destitute of silex.

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* The term "variegated sandstone" being already appropriated, as designating a member of the new red sandstone series, it becomes inapplicable to this rock, which is a member of a much older formation. Besides this, there are only a few of the upper strata which are variegated.

The rock below the grayband is variegated to the depth of 20 or 30 feet, with gray or greenish gray spots and seams. Although this formation has been called sandstone, much the largest proportion of it is an indurated marl, containing too little siliceous matter to entitle it to the name of sandstone. On the Niagara river, where there are more than five hundred feet in thickness developed, we find no more than forty feet of a siliceous character. The disintegration of this rock has produced a soil corresponding to the varying constituents of the rock beneath. The marl in the lower part of the formation is striped, vertically and horizontally, with seams of green shale.

Following the course of this rock westward, from the point of its greatest depression in Wayne county, it gradually rises, and at the Niagara river has attained an elevation of two hundred feet above the lake. In the eastern part of our district this rock is more siliceous than farther west; this character is observable in the soil and boulders on the surface as well as in the rock beneath. After passing the Genesee river, the great mass of this formation is an indurated marl, giving rise to loamy soils, except where strata of limited extent occur, possessing a siliceous character.

The surface of this formation is undulating, as may be seen by tracing the canal in its course, the level of which first comes upon the sandstone in Sweden, Monroe county. At Medina, farther west, the canal is excavated ten feet into the rock, and again at Lockport the top of the sandstone is twenty feet below the canal. Some allowance must be made for the deviating course of the canal which at some places is farther north or south than it is at others. Where the canal first comes upon the sandstone west of Rochester, it is at a point four miles farther north than at Rochester; this will account for the circumstance without supposing that the sandstone is more elevated than would be produced by the dip.

At Medina, about forty feet from the top of this rock, we find a stratum, two feet thick, of siliceous sandstone of a greenish gray colour, containing Lingula Cyclostoma, Planorbis, Unio and Cytherina. Following this stratum, or bed, westward, we find it on the Niagara river twenty-five feet thick, of a coarse and highly siliceous texture. At this place, its surface is sixty feet below the grayband: the rocks above and below it are the red marl. This stratum evidently thins out in an easterly direction, as it is not seen east of Medina.

Mr. Conrad, (Geol. Report, 1837,) mentions the occurrence of the fresh water and marine shells just noticed, at Medina, and supposes them to have been transported from their fresh water habitations by a gentle current running into the ocean. I am gratified in being able to add another fact, in proof of the existence of a current, during the time this *distinct* stratum, or bed of sandstone was deposited. Near Lockport, this stone is quarried for flagging stones; it divides into layers of from half an inch to four inches thick. The Lingula are discovered at this quarry, on the surface of different layers, from two to five feet below the top of the stratum. As the layers are removed, these Lingula present a singular appearance, having their mouths all arranged in the same direction, and appear to be disposed, at regular intervals, over a great extent of surface. The direction of the mouth is to the S. E. by S. and the beaks in the opposite direction, or N. W. by N. There is a little ridge of stone extending from the beak, and gradually sloping down to the regular surface of the rock, like a deposit of sand, before some obstacle in a current. On each side of the mouth, or widest part of the shell, there is a depression, evidently produced by the current, and corresponding precisely with what we observe where a current of water meets an obstacle, as it would in this case, in the Lingula attached to the sandy bottom. Their mouths were, doubtless, in the direction from which the current came, for the purpose of obtaining food. It is impossible to avoid the conclusion, that the surface of each of these layers was once the original surface of the sandy bottom of an ocean, covered with living shells, over which a gentle current flowed. There appears to have been a considerable interval between the deposition of one stratum and the next, for we find several successive layers with the Lingula arranged in this manner; and I have never seen them imbedded in the rock, or in any other position than the one described.

The direction of the current is pointed out by the ridges extending from the beaks of the shells, and we thus have evidence of its course in the sea, from which this rock was deposited, as well, and as certain as of the diluvial current from the scratches on the surface rocks, or of a recent current from its action on a soft and yielding bed of sand or clay. Besides the fossils already noticed, we find in the upper part of the formation the Dictuolites Beckii, and Fucoides Harlani.

The grayband, which is a distinct stratum of four or five feet thickness, at Rochester, is represented by a few inches of gray marl at Lockport, and is ten feet thick on the Niagara river, where it passes imperceptibly into the red rock beneath. Small particles of pyritous copper, and green carbonate of copper, occur in the grayband at Lewiston.—Iron pyrites occurs in the red sandstone at Holley, Orleans county.

The points at which this formation can be most advantageously examined, are along the Genesee river, below Rochester, at Medina, Orleans county, and along the Niagara river, near Lewiston.

SECTION II.

Argillaceous and Calcareous Shales of the Genesee and Niagara rivers.

The marl and sandstone just described, are succeeded by a series of argillaceous and calcareous shales, with interposed beds of limestone.—The lower portions are argillaceous, with thick beds of siliceous limestone. The upper portions are calcareous, with seams, or thin strata, of blue limestone; the whole changing, above, into an impure limestone.*

Resting on the sandstone at Rochester, we have a green shale, about twenty feet thick, the upper portions alternating with thin strata of siliceous limestone. Above the shale, we have a stratum of argillaceous iron ore, about one foot thick. Above this, we have calcareous and siliceous strata, of about fourteen feet thickness, separated throughout by thin seams of shale. Upon this rock, we have twenty-four feet of green shale, similar to that below, and above this, eighteen feet of silico-calcareous strata, separated by seams of shale. The last is not so siliceous as that above the lower green shale. The green shales, both lower and upper, consist of irregular laminae, very fissile and tender, and on exposure, readily dissolving into a tenaceous clay. The lower stratum is commonly of a bright green or blueish green colour, but changes on exposure. The upper shale is of a less vivid colour, often inclining to a grayish green. The strata of siliceous limestone interposed between the two shales, are coarse grained, and of a harsh texture, breaking into irregular blocks. Some of the more siliceous strata are compact and fine grained, and some portions, in thin strata or masses, have become cherty or chalcedonic. We often find specimens of pure chalcedony in stalactitic or mamillary forms, lining the geodes or fissures. The chalcedonic portions consist, mostly, of organic remains, which appear to have been broken and transported before the deposition took place. These fossils are of trilobites, Producta, Orthis, &c. This limestone contains a stratum of about one foot thick, composed almost entirely of the broken shells of Pentamerus; it is very well defined at Rochester, but its position cannot be relied on as will be seen farther on. Above the upper green shale, at Rochester, we have the calcareous strata, noticed on the last page. This rock closely resembles the more calcareous portions of the strata above the lower green shale: it may be described as a silico-calcareous rock, extremely hard and tough, containing masses and nodules of iron pyrites, which, on decomposing, leave the spaces filled by anhydrous gypsum. The decomposition of pyrites, and the formation of gypsum in nodules takes place in all the rocks between this and the gypseous formation. This rock, when exposed, becomes covered with a deposit of an iron rust colour, resulting from the decomposition of pyrites, which not only occurs in nodules, but disseminated in grains throughout the rock. On this account it is very destructible, and wears away by the action of the weather faster than the shale. At Rochester, we find the rock just described, and the upper green shale entirely distinct from the similar rocks below, and also from the calcareous shales above. On going westward, a few miles, the upper green shale disappears entirely, and allows the two calcareous rocks or limestones to come in contact, and form one rock, with the lower portions siliceous and the upper calcareous. After the union of the two rocks, the upper portions contain Encrinites, Corallines, Spirifer, Orthis, &c., while the lower portions retain the same fossils as when the rocks were distinct. The two rocks, after their junction, are only twenty feet thick, whereas when separate, the two together were more than thirty feet thick. On the Niagara river, the lower portion of this rock is a magnesian limestone, with pyrites disseminated, causing a rapid decomposition of the rock, and the production of a large quantity of sulphate of magnesia.

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*The lower shale and siliceous limestone of this series, have been called the "Ferriferous rocks," by Prof. Eaton. This term may be applicable to these rocks, in some places, but is peculiarly inappropriate for the whole series, as iron is no where found in these rocks between the Genesee and Niagara rivers. The term "Sandrock," cannot, with propriety, be applied to any portion of these rocks, except a few feet of the lower bed of siliceous limestone at Rochester. Both the "Ferriferous slate," and the "Ferriferous sandrock," are distinctly repeated above the iron stratum, in a second green shale, and a second bed of siliceous limestone. The upper green shale and upper limestone are easily mistaken for the series below, indeed the distinction is merely nominal, depending on the accidental presence of iron ore.

The lower green shale, which at Rochester is twenty-three feet thick, is only three feet at Medina, and disappears entirely before coming to Lockport. At the latter place the shale and grayband are both represented by eighteen inches of greenish gray marl. Soon after leaving Lockport, the green shale commences again, and on the Niagara river is eight feet thick, and probably attains a much greater thickness farther west.

A few miles east of Rochester, we find the Pentamerus, which was there confined to a stratum of one foot in the lower bed of limestone, distributed through several feet of thickness in the limestone, above the upper green shale. At the Shakers' mill, in Wayne county, we find this fossil distributed through twelve feet in thickness of rock. This rock, which is almost destitute of fossils at Rochester, fifteen miles farther east contains Pentamerus, Catenipora, Tubipora, Encrinites, &c.—The Pentamerus of the lower stratum disappears before coming to the Niagara river.

The lower green shale contains but few fossils, while in the upper green shale we have Agnostis, Calymene, Asaphus, Producta, Orthis, &c. About six feet from the upper surface of this shale, we have a thin stratum, sometimes dividing into two or three, which consist almost wholly of fossil shells of a single species. These fossils have a beautiful pearly or testaceous lustre.

SECTION III.

Argillaceous Iron Ore.

The stratum of Argillaceous iron ore, mentioned in connexion with the rocks just described, consists of distinct concretions or flattened grains, having a laminated structure. Its colour is reddish brown, it has an unctuous feel, leaving a stain upon the fingers. In some localities, the mass of the ore is composed of fragments of encrinital columns, and other corallines, with Producta, Catenipora, &c. Many of these fragments are changed into the substance of the ore, and others still remain carbonate of lime. The latter mineral in seams and thin layers is of frequent occurrence in the ore. The ore contains sufficient argillaceous and calcareous matter to act as a flux, but the cinder is too fluid unless loam or some other earth is mixed with it.

This stratum of ore has been described as extending from near Little-Falls, to thirty miles beyond the Niagara river. I have not, however, been able to find it between the Genesee and Niagara rivers, and I am quite confident that it does not exist within this limit, unless it may be for a short distance west of the Genesee, where the rocks are covered by the superficial soil. Its width, too, which has been stated at twenty miles, is very erroneous, it being merely the outcropping of the stratum where it comes to the surface. At Rochester, this stratum of ore is about one foot thick; fifteen miles farther east it is three feet thick, and where it has been worked in Wayne county it has the same thickness. This stratum, like the shale below, thins out west of the Genesee, and like that, may perhaps be found again west of the Niagara river.

This ore is very similar to that often associated with coal and coal strata, and we find in the south part of the State, and in Pennsylvania, similar ores. The presence of this kind of ore is not, however, an indication of the existence of coal in the vicinity, as the situation of the stratum under consideration will show.

The fossils of the iron ore are all of marine origin, consisting of fragments of Encrinites, Corallines, Producta, &c.

SECTION IV.

Calcareous Shale.

The argillaceous shales and beds of limestone are succeeded by a calcareous shale of a dark colour, extremely soft and fissile below, but becoming harder and more calcareous above, and finally changing into a limestone. The lower portions disintegrate readily on exposure to atmosphere and water. After long exposure, this rock becomes a clayey marl, forming a fertile soil. Thin seams of green shale, like that below are interlaminated with this rock throughout its whole thickness.

This rock has been called " Calciferous slate," by Prof. Eaton, but he has described three or four distinct rocks under the same name, viz. The formation of which we are now speaking; the gypseous rocks which are separated from this rock by the geodiferous limestone, and the slates of Canandaigua and Geneva, which are above the mountain limestone.— He also mentions the slates of Otsquago creek as being a part of the " Calciferous slate ;" the latter are below the sandstone of the 4th District.

The calcareous shale of Rochester may, in its eastern prolongation, meet the gypseous rocks at Manlius and other points, by the thinning out of the limestone which separates them. Whatever term we choose to apply to the shale of Rochester, there will be no difficulty in recognizing its place in the series of rocks. It is separated from the sandstone below, by the green argillaceous shale and siliceous limestone, and it is directly beneath the limestone of Rochester, Lockport and Niagara falls. There is no other limestone shale which resembles this till we rise above the carboniferous limestone; and after seeing the two, in place, no one will be likely to confound them. The gypseous marls and slates are very different from these under consideration. The fossils in these rocks are a sure guide, where the lithological characters might mislead.

The calcareous shale extends from the eastern limit of Wayne county, to the Niagara river; at this place it is eighty feet thick, and at Lockport, about the same thickness. It forms the northern slope of the mountain ridge, from the Genesee river westward; and a line from the upper falls at Rochester to the falls at Wolcott, in Wayne county, would be its southern limit, east of the Genesee river. Its width is from one to two miles, according as the surface is level or inclined. It abounds in fossils throughout its whole extent, containing five species of Trilobites, several species of Producta and Orthis, Encrinites, &c. The decomposition of this shale affords sulphate of magnesia and muriate of soda: small nodules of gypsum are of frequent occurrence, and also pyrites, in disseminated particles, extending through a considerable thickness of the strata. Owing to the latter circumstance, as well as to its composition it is readily decomposed by the action of air and water. It is this shale which underlies the limestone of the Niagara falls, and by its decomposition leaves the limestone unsupported, when it falls of its own weight.

This formation retains the character of shale, or slaty argillaceous limestone, for a thickness of about eighty or one hundred feet, when, from the increase of siliceous and calcareous matter it loses the character of shale, and becomes a compact, silico-argillaceous limestone.—Some of the strata of this part of the formation have been used for hydraulic cement, but there is no rock to which the name, hydraulic limestome is exclusively applicable.* This portion of the formation is irregularly stratified, the strata being from a few inches to three feet in thickness, often divided in different directions, by seams of greenish shale. This rock is of a greyish blue colour, coarsely granular, compact and sub-crystalline. In its upper portions it becomes a more pure limestone, and finally, graduates into the geodiferous limestone of Eaton. In the same manner, throughout all the limestones and shales, above the sandstone, there is a gradual and almost imperceptible change from one to the other.

The rock of which we are speaking is better developed at Rochester than at any other place in our district: it is here quarried in the bed of the river for laying the foundation of the aqueduct. When free from seams of shale, it is a valuable and durable building stone. The lower strata of this rock form the bed of the river at the upper falls, of which the water of the Genesee is precipitated upon the shales below. At this place it has a thickness of sixty or seventy feet, but diminishes westerly, so that at Lockport and on the Niagara river it is no more than eight feet thick.

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* The upper strata of the gypseous formation are used for the same purpose, and also the silico-argillaceous portions of many limestones.

A few miles west of Rochester we find interposed between this rock and the Geodiferous limestone, a stratum of light gray siliceous limestone, of a porous and crystalline texture. In some places this rock abounds in fragments of encrinital columns, which are perfectly crystalline, and stand out in relief where the other portions of the rock have been removed by the action of the weather. This is the same rock which at Lockport furnishes the fine building stone so extensively used in that vicinity. The greatest thickness of this stratum within the limits of our district does not exceed thirty feet.

SECTION V.

*Geodiferous and Bituminous Limestone.**

The shale and limestone last described are succeeded by the " Geodiferous limerock" of Prof. Eaton. This limestone is well characterized at Lockport and at Niagara falls: farther east it loses the geodiferous character, and diminishes in thickness. The rock is regularly stratified, compact, of a gray, bluish gray or brownish gray colour. It is sufficiently distinguished from all other limestones by its finely granular texture, presenting on fracture numerous shining points: the lustre is vitreous, or resinous. The resinous lustre is produced by bitumen, which colours the small crystalline laminæ. The most striking feature of this rock, in the localities referred to, is the numerous cavities, or geodes, many of them filled with anhydrous gypsum, or lined with crystallized limestone or fluer spar. The beautiful specimens of dogtooth and rhomb spar, with sulphate of strontian and selenite from Lockport and Niagara falls, are from cavities in this rock. Blende also occurs in the cavities with the minerals mentioned. Many of these cavities present some partially decayed organic body. In some places the structure of the rock is very irregular, presenting curved, contorted and concentric laminæ, as if the mass had been disturbed when partially indurated. The whole of this rock is bituminous, particularly the upper portions; the odor is perceived on percussion.

At the Niagara falls there are about eighty feet of this rock disclosed; the lower portions are gray, becoming darker, and containing more and larger geodes as we ascend. At the top of the falls it is of a brownish gray colour and resinous lustre, containing blende disseminated and in geodes. Above this, there is a thickness of about one hundred feet, which is less geodiferous, and inclining to a bluish color. The uppermost part of this rock consists of thin, almost slaty laminæ, with a curved or contorted structure (see figure) resembling short undulations, gently curved on the upper surface, but meeting in the depression or concave very abruptly. In some cases the surfaces of these curved laminæ are covered with small knobs or protruberances, often arranged in quincunx order. These thin layers are separated by a thin seam of bituminous matter; they are very brittle, and when struck with a hammer give a metallic sound, like clinkstone.

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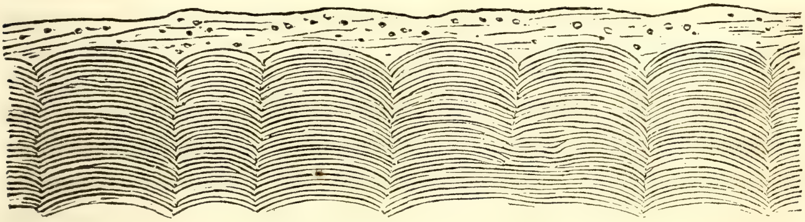
* Though both these terms are applicable to the rock under consideration, the same characters are also possessed by the carboniferous limestone at Black Rock.



The name swinestone, or fetid limestone, is peculiarly inapplicable to this rock, as it has nowhere a fetid odor. The odor produced on percussion is that of bitumen, and the same is perceived on burning the stone for lime, when the fluid bitumen, of the consistence of tar, escapes and is consumed, giving rise to the odor which has been termed that of burned horns or leather.

In the eastern part of our district, this limestone has lost its geodiferous character, and has greatly diminished in thickness; but it still retains its essential lithological character and bituminous odor. The term geodiferous, which distinguishes the western portions of this rock, is here inapplicable.

This limestone is highly magnesian throughout its whole extent; still no portion of country can be more fertile than that along the range of this rock. The northern limit of this limestone from the Genesee to the Niagara river, is the edge of the limestone terrace. East of the Genesee river its northern limit is in a line drawn from Rochester to Wolcott, in Wayne county. Its width is from four to eight miles.

SECTION VI.

Gypseous Marls and Slates.

Superimposed upon the rock just described, we find an extensive series of slates, indurated marls, siliceous and argillaceous limestones, the whole formation marked by the predominance of argillaceous matter. This formation is peculiar and well defined, resting on the geodiferous limestone; it terminates with the mountain limestone, which is one of the best characterized and most extensive formations in the State. The lower portions of this series are indurated marls, sometimes slightly siliceous in the lowest strata, but becoming almost entirely argillaceous, containing seams of fibrous gypsum and small masses or nodules of selenite and anhydrous gypsum. Above this we find a considerable thickness of a tough indurated marl, of a green or bluish green colour, with seams of flesh coloured gypsum. This rock is exceedingly difficult to remove, even by blasting, but after a few days, or even a few hours exposure, it crumbles into fine particles, and finally dissolves into a clayey mass.

The succeeding strata are more calcareous, and in some places become a tolerably pure limestone, of a slaty structure. The green marl, like that below, often alternates with these strata. Towards the upper part of the series, we find frequent alternations of the green or bluish green marl, and a compact earthy limestone. Thin strata of vesicular limestone are observed toward the top of the series.

These rocks embrace all the gypsum of importance in the 4th District, and may with propriety be called the gypseous rocks, as they are not likely to be confounded with any other formation. These rocks, west of the Genesee river, are all bituminous, as is the gypsum in many places. The gypsum in the lower part of the formation, is limited to thin seams or nodules, but after the commencement of the slaty limestones, it is found in large masses, or beds, of a few feet thickness, and limited extent. These masses are of a flattened spherical form, and are from a few pounds to fifty tons weight, commonly from five to twenty tons. The existence of these beds of gypsum is indicated by appearances of the surface, which above the mass is raised into a knoll or hillock. Sometimes the surface, to a considerable extent, is covered with these hillocks, which resemble small mounds of earth. When the soil is removed from one of these elevations, a corresponding convex surface is presented by the limestone beneath, which is cracked and broken in every direction, as if by some elevating force. On removing the stone, further evidence of such force is perceived. The layers of limestone dip upon every side of the mass of gypsum, and as this mass thins off at its edges, the strata of limestone meet those below and assume their original, nearly horizontal position. From such appearances we cannot doubt but the gypsum has been formed since the surrounding rock become indurated; and that the production of these masses has disturbed the overlying strata. The decomposition of large quantities of iron pyrites might, perhaps, explain the formation of gypsum, by a decomposition of the limestone, but there is very little pyrites now remaining in the rock. The masses of gypsum are sometimes stained on their edges with iron, and bog ore is of frequent occurrence in the neighborhood. Hydro-sulphuretted springs are common, and the water of some wells is of similar character. The water of some of these springs corrodes iron rapidly. In the town of Byron, Genesee county, there is a spring arising from this formation, containing free sulphuric acid.

Immediately surrounding each mass of gypsum we find layers of loamy clay, called ashes by the workmen. This ashes contains disseminated particles, and sometimes scarcely aggregated, friable masses of gypsum. We have in this "ashes" precisely what would remain of the argillaceous limestone, should we abstract the calcareous matter by sulphuric acid, or any other process.

It is said by the inhabitants, that the small elevations indicating the presence of gypsum are not observed till after the country has been cleared of its forests, or in places where there has never been trees growing. These changes in the contour of the surface are observable from one year to another. In some places a mass of gypsum has formed under a building, altering the level of its foundation and disturbing its equilibrium. Points on the surface which are now but slight elevations, will in a few years become more elevated. However unaccountable these circumstances may appear, I have no reason to discredit the assertions of numerous respectable authorities.

In some places, where the rocks of this formation approach the surface, they are decomposed into a clayey marl, much resembling the ordinary clays, and it has sometimes been used for similar purposes. This marl, however, contains too much carbonate of lime for the common purposes of clay. In some places, where this rock is calcareous, the surface is cracked or furrowed in every direction, like a bed of wet clay drying in the sun. These furrows are water-worn, and give a singular appearance to the rock.

The gypsum beds are commonly from four to eight feet below the surface; sometimes two tiers of beds are found, one overlaying the other. The crevices and fissures in the rock above the gypsum admit large quantities of water, and we often find a water-worn cavity or fissure in the bed of gypsum, and the channel through which the water escaped below. By this means any iron from decomposing pyrites might be carried off.

The rocks forming the termination of this series consist of regular strata of a silico-argillaceous limestone, with thin seams of siliceous matter, often resembling chalcedony or agate. In some localities there are strata which are almost entirely siliceous, and are used for a fire-stone. The rocks of this part of the series are extensively used for building stone and hydraulic cement. These rocks, in most places, change gradually into the carboniferous limestone above, but sometimes the line of separation is very distinct. At Mendon, in Monroe county, the two rocks are separated by a thin stratum of siliceous conglomerate, of a green colour. This conglomerate contains fragments of the rock below, showing that it was in some degree indurated before the deposition of the carboniferous limestone.

In an economical point of view, this formation is the most important of any in the Fourth District; its resources throughout a great portion of its extent are at this time undeveloped, and it is only when its limits and extent shall become known, that its immense value will be appreciated. In our district, this formation occupies a considerable portion of the southern part of Wayne, Monroe, and Niagara counties, and of the northern part of Erie, Ontario, and Seneca counties. Its width is from eight to ten miles, and its aggregate thickness four to five hundred feet. The gypsum is mostly confined to the upper rocks of the series.

Fossils are of rare occurrence in this formation, so far as our observation has extended. Specimens of Orthocera, Trilobite, univalve and bivalve shells, have been found in Wayne county.

In some parts of this formation there appears to have been a tendency to crystallization, or some peculiar arrangement of the particles. In breaking the rocks, small masses sometimes separate, generally of a flattened form, but often nearly cubical or approaching to octahedral forms; having on one part the adjacent planes of a solid angle deeply striated. These forms present some analogy to the hopper form crystals peculiar to the muriate of soda; and Prof. Eaton has considered them as pseudomorphous crystals of this salt. Their position, however, and their relation to the surrounding rock, sufficiently proves the contrary. They are found in the solid rock as well as in the decomposing marl; and when removed leave a corresponding impression in the surrounding mass; they are also of precisely the same composition as the rock in which they occur. The rocks of this formation are also far above those which supply the salt springs, and can never have had any communication with them.

In the rocks of the upper part of this series, and also in the bituminous limestone below, we find an arrangement of parts, presenting, externally, a ligniform appearance. In breaking a mass of the rock, we often observe portions to separate, presenting the appearance of blackened wood; these are coated with bituminous matter, often bright and shining. These ligniform masses are often four or five inches long, and not more than one-fourth, or half an inch thick: again, we find them very short, and several inches thick. Sometimes the fibrous portions are so short, as to present only an undulating seam in the rock. These curious formations have been called Lignilites, but they possess no organized structure, and the ligniform appearance is doubtless owing to the bituminous matter.

Carboniferous or Mountain Limestone.

This rock succeeds the gypseous formation, but as it occupies very little of the counties which have been minutely examined, its description will be deferred for a future report.

SECTION VII.

Diluvium and Diluvial Action.

The indications of diluvial action are every where perceived in the accumulations of gravel, sand and pebbles, with boulders of all dimensions strewed over the surface. Diluvial hills of considerable elevation are found in Wayne, and the eastern part of Monroe counties; but from the Genesee to the Niagara river, the country is comparatively level throughout the northern counties, with the exception of the mountain ridge. The soil, however, is of diluvial origin, and the surface is strewed with boulders, many are of rocks foreign to the district.—These boulders consist of the various granites and gneiss, together with those of the sandstone from below, and of the limestone from above. Besides this unequivocal evidence we have other, and if possible, more positive proof, in the furrowed and polished surface of the limestone, which is seen wherever the rock is exposed, from the Genesee to the Niagara river. The surface of this rock bears palpable evidence of the wearing action produced by running water, carrying with it heavy materials of sufficient hardness to wear away, and in some instances, actually to polish the surface of the rock over which it passed. Where the rock is exposed we find the surface has been worn, in some instances, till it is perfectly smooth, and in others the original inequalities are but partially obliterated. We often observe that the abrupt offsets from one thin stratum to another, have been worn down to a gradual slope. In some places slight scratches only are perceived, while in others they are numerous and deep, often extending for several feet, and in one case a continuous furrow was observed one hundred feet in length. The general direction of these scratches is N. N. E. and S. S. W.; sometimes there are slight variations from this course. The appearance of the scratches often indicates that they were produced by two boulders coming in contact, when the lighter one was moved out of its course, producing a furrow in the direction of the force applied.

In pursuing these investigations, we are irresistibly led to the conclusion, that an oceanic current has flowed over the limestone terrace, from the Genesee to the Niagara river, and indeed over the whole western part of our State. Whether this ocean existed before or since the uplifting of these rocks, perhaps we cannot determine; but appearances strongly indicate that the face of the country was the same as it now is. There are also many circumstances that would favor a conclusion that the current was from the south, passing over the surface of the limestone till it came to the softer shales and marls on the north, which are worn down, abruptly, at the termination of the limestone. The limestone, marked by these scratches, crops out on the north at the edge of the terrace, and from this point there is an abrupt descent over shales, soft sandstones and marls. The descent, from the top of this terrace to the level of the country on the north, at its eastern extremity, is about thirty feet, but in the western part of our district the descent is more than two hundred feet.

Where the soil is removed from the polished and furrowed rock, we find resting upon it, in many places, an irregular deposit of pebbles and boulders, some of the latter of large size. These are frequently cemented by a gravel or hard pan, with infiltrated carbonate of lime.—Above this stratum we have clay, sand, and loam, with little or no coarse materials. These boulders are of various granites, limestone from the formation on which they rest and from the south, and siliceous sandstone from the north. These materials all attest the action of violent currents, and not of a single and uniform current, but of opposite or conflicting ones. The presence, in the same locality, of boulders from the north, with those from the south, proves that opposite forces have prevailed either at the same or at different periods.

The extent of these diluvial formations, with the great numbers of erratic blocks, and the evidence of long continued wearing action on the limestone, prove that the force was not sudden and violent, but continued for an indefinite period. If, then, we admit the presence of an ocean covering the continent or a part of it, we should also admit the condition of an ocean as we find it at the present time.

In the Atlantic, we have the ebb and flow of the tides, which, with violent winds, are sufficient to remove detritus in considerable quantities. This action is much more violent in some places than in others; it is also alternate and opposite. We have also equatorial and polar currents: The one in the gulf stream transporting light materials from the equatorial regions to mingle with the coarser materials brought from the north on islands of ice by the polar current. At the meeting of these currents the materials of both are gradually precipitated as the opposing forces neutralize each other. The ice islands, as they are dissolved by the warm current from the south, would precipitate their immense loads of northern matter to the bottom of the ocean, in a line corresponding to the course of the current. Each current, too, is constantly depositing along its course the heavier materials, carrying forward those only, which require less force as the current is diminished in velocity from the resisting medium. Under these circumstances, we may perceive, that we would sometimes have a deposit, mostly, or entirely, from one quarter of the globe; and at others, from the opposite one, and in many cases from both directions. The banks of Newfoundland and St. George, are probably depositions from the two opposite currents, and in these deposits we may find materials from very distant quarters of the globe. May not some of our diluvial deposits have resulted from similar currents? The agency of running water, in producing our diluvial deposits, is very obvious, and acknowledged by every one, but the effects have been ascribed to a current from one direction, and that from the north. We have thus overlooked the necessary considerations of opposite currents, arising from an ocean resting over our continent.

In many cases we find the coarser materials on the southern slope of the hills, and the ascent in that direction more abrupt than on the north. We find, in many places, large numbers of granite boulders in the same deposit with those of limestone, the latter, either from strata directly beneath, or from those farther south. When the limestone fragments are from the stratum directly beneath, they are much more worn and rounded than we could expect, unless they had been whirled in the eddies of the passing currents, and suffered wearing action from transported matter. It is very obvious, too, that the cause which transported the granite boulders from the northern regions did not effect in the same manner the limestone and other strata of western New-York.; for although we find boulders of granite extending beyond the southern boundary of the State, we rarely find boulders of the other rocks far south of the stratum to which they belong.

SECTION VIII.

*Lake Ridge.** *Ridge Road.*

One of the most remarkable features of the surface of the Fourth District is the "Lake Ridge;" which is a travelled highway from Sodus, in Wayne county, with some slight interruptions, to the Niagara river. West of the Niagara river, we find a continuance of this ridge, and it probably passes round the head of Lake Ontario. Throughout the greater part of this distance, the ridge is well defined, being a slight but actual elevation above the general surface of the country. In some places, the descent is abrupt on either side of the ridge, but in general it is gradual. The elevation of this ridge above Lake Ontario is, in Niagara county, about one hundred and sixty feet, though there are variations of a few feet. The course of the road along the ridge should not be taken as a guide for its elevation, as in some cases the road passes over the point of a hill which projected into the ancient lake, and at which place the ridge is not so well defined. In other cases the ridge has been partially removed by streams, as a beach now is forming along the lake shore. We often find this ridge divided into three or four parallel ones, which extend for a few rods and then unite in one. The elevation of the country on the north is exceedingly uniform, and from the foot of the ridge there is a gentle, almost imperceptible descent, to the lake shore. North of the ridge there are no valleys but such as have been worn by the present streams. The country on the south is not so uniform. In many places we find transverse ridges, jutting upon and terminating at the lake ridge. The road in some places is at the termination of such a transverse ridge, and at other times over the top of it.

The course of this ridge is nearly parallel to the lake shore, and from four to eight miles distant. The width of the ridge at the base is from four to eight rods, narrowing to the top, which is often not more than two rods wide. In many places it much exceeds this width.

It is the prevailing opinion that this ridge has been the shore of Lake Ontario, at a period when it had a greater elevation than at present. There is indeed sufficient proof of this fact in every appearance of the ridge, its materials, and in the surface of the country on the north and south of it. The soil on either side of the ridge is generally a clayey loam, while the surface of the ridge is of sand or fine gravel. The whole of the ridge is superficial, being composed of sand, gravel and pebbles; the latter of sandstone, or other siliceous rock. All the materials are similar to those forming the beaches along the present lake shore. There is no connexion between the ridge and the rock below, except that the rock supports the ridge without altering its form or course.* The elevation of Lake Ontario to the level of this ridge furnishes the only plausible means by which we can explain its present appearances; and however reluctant we may be to admit such a condition, we are forced to do so from the abundant evidence furnished.

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* This term is applied to the most striking feature of the four lake counties described in this report, in consequence of its supposed origin. It is also referred to as the Ridge, the local and universal name applied to it by the inhabitants of the western part of the State.

The uneven country on the south side of the ridge is, in many places, strongly contrasted with the uniform elevation and gentle slope on the north. The absence of inequalities in the surface on the north of the ridge, and at the same time the presence of boulders and pebbles, showing the action of currents, can only be explained by supposing some gentle force like the lake waters to have reduced the ridges and hills, and have distributed the materials equally over the surface.

After the subsidence of the ancient lake, the accumulation of water south of the ridge forced the barrier, and has worn itself a channel to the lake shore. In pursuing these water courses, we find a uniformly narrow channel till we approach the ridge from the south, when there is a sudden expansion, which after passing the ridge assumes a narrow channel till near the present lake shore, when it again expands. We sometimes find extensive swamps, limited on the north by this ridge; in some of them there has not been a sufficient accumulation of water to force a passage through the ridge, and artificial outlets have been made for drainage. By this process large tracts of valuable land are being reclaimed.

Wherever wells have been dug, or excavations made in this ridge, fragments of decayed wood, bark, and often branches and trunks of trees, are found deeply embedded in the soil. Shells of the Unio, &c. are also said to have been found, but I have not been so fortunate as to obtain a specimen. In one excavation I obtained fragments of bark, wood, and part of a branch, the latter of which was partially mineralized, presenting the appearance of charcoal, but harder, very brittle, and with a shining lustre. These specimens were obtained from about six feet below the surface, where there appeared a thin stratum of fragments of wood, bark, &c, as if it might have been accumulated on the surface of still water, and afterwards covered with sand and gravel.

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* Prof. Eaton has supposed this ridge to be formed by the outcropping of a stratum of the red sandstone; but in many places the ridge is not underlaid by sandstone; and often where it is, that rock does not approach to within thirty or forty feet of the surface.

It has been urged as an objection, that the ridge slopes on both sides; but this, so far from being an objection, is a proof that it was an ancient shore. If we examine the shore of a lake or sea where the inland country is not far above the level of the water, we find there is always a ridge accumulated. This is a natural effect from the action of the waves and of ice, pressing the loose materials onward till they are raised into a ridge, which is still increased by the wind blowing the fine sand upon it, which is deposited along the base.

The ridge furnishes, perhaps, the best natural road in the country, being from its nature at all times in good condition for travelling; and at such seasons as the other roads are almost impassible, this one is scarcely affected. The surface is commonly of fine gravel or sand, with coarser materials below, which allows the water to be absorbed and pass off beneath. Its convex surface and slope on either side also prevents any accumulation of water.

The detailed examination of the counties of Wayne and Orleans was assigned to *Dr. Geo. W. Boyd*, the assistant geoloist to this district, and the economical geology of the above two counties was furnished by him for this report.

LOCAL AND ECONOMICAL GEOLOGY.

Wayne County.

Surface of the Country.

South of the ridge road the country is occupied by numerous parallel ridges, narrow and long, rising about 25 to 35 feet above the general level, and having uniformly a north and south direction. The ridges are composed of sand and gravel.

These ridges extend regularly as far north as the ridge road, where they all terminate. This was observed particularly in the towns of Sodus, Williamson, and Ontario. We saw no instance in which these ridges cross the ridge road.* On the old Sodus road we travel northward, for about a mile, between two of these parallel ridges, which are here quite as high as any in the county, when, upon descending a little towards the flat country, the ridges terminate, and here a continuation of the lake ridge, connects the points of these ridges or hills. This place is about half a mile south of Griffith's tavern in the town of Sodus. From this point to the lake the country is a gradually descending plain.

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* This circumstance is referred to particularly, because the fact is important, in considering he origin of the *lake ridge*.

The ridges about Clyde, and generally in the town of Galen, north of the canal, are numerous, long, narrow, low, and have a north and south direction.

Ridges in Lyons are also long, narrow, and low; both sides and top are cultivated.

The only exceptions to the northerly direction of the ridges were noticed in the town of Walworth, near Walworth corners, where are two or three east and west ridges, upon one of which the village is situated. These ridges are the highest land in this part of the county, between lake Ontario and the Erie canal. Also, in the town of Macedon, between the centre and Erie canal, the country is broken, and the hills irregular.

East and west roads are hilly, as they pass over a succession of the ridges above mentioned. North of the ridge, in Wayne county, the country descends gradually to the south from the ridge, and presents a uniformly level surface, until near lake Ontario, where it is more or less broken and hilly, but in an irregular manner. West of the village of Sodus, proceeding northward, the country is generally a descending plane, land quite level, and more sandy than south of the ridge. This level country continues, until within a mile or two of the lake, when it becomes broken and irregular. In the towns of Huron and Wolcott, near the lake, the country is broken and hilly, elsewhere it is pretty level. The hills have no uniform direction north of the ridge, but frequently run north and south. On the road from Sodus village to the Forge, the first two miles is a gently descending country; the last two miles present a broken, sandy surface, and short iregular hills appear on all sides. Between the Forge and Sodus point the country is broken, and several short and steep hills appear along the road, which here runs close to the lake: the bank is bold and steep, and almost perpendicular, composed of sand, and is from 80 to 100 feet above the surface of lake Ontario. From the village the ground descends gradually to Sodus bay.

Lake Ridge.

This remarkable ridge continues quite uniform and distinct as far east as the village of Sodus, running parallel to, and about four miles distant from Lake Ontario. At the village of Sodus, it is but three miles from the lake, and about half a mile east it turns rapidly to the south. It is seen distinctly in the southeast part of the town of Sodus, a little south of Griffith's tavern. Here it meets the northern termination of two north and south ridges, and connects them; at this place we collected well characterised ridge pebbles. From this point, the ridge continues southeasterly to Rogers' corners, where it turns south for three or four miles, then east again, which brings it into the north part of the town of Galen, about the high swampy ground which is the summit level of the Sodus canal: it probably crosses the Erie canal somewhere near Clyde.

The country frequently descends immediately south of the ridge, and then again rises. In some situations, the ground both north and south of the ridge is swampy.

The *ridge road*—sometimes called the alluvial way—is continued on the summit of the ridge as far as the village of Sodus, and as the country then descends to the east, and the lake ridge turns to the south, the continuation of the road through Huron and Wolcott towards Oswego does not properly deserve the name of ridge road.

It is the general opinion of residents near the ridge, that this was the ancient beach of Lake Ontario, when the latter occupied a higher level, and its character and general appearance are such as will strongly support this supposition. The ridge pebbles are smooth, rounded stones precisely similar to those on the present beach of the lake, but differ from the pebbles of the numerous north and south ridges mentioned previously as occurring south of the ridge road. In travelling upon the ridge it will be noticed that the road occasionally descends a little, and again rises, but judging by the eye, the country from the foot of the ridge north, is uniformly plain and level, except where intersected by streams.

According to estimates made upon streams running from the ridge to lake Ontario, its height above the lake appears to exceed 200 feet, but upon this point we are not prepared at present to give positive information.

Shore of Lake Ontario.

The lake shore in Wayne county is generally bold, and composed of a bank greatly varying in height. About the mouth of Salmon creek it is ten feet high; at Pulteneyville, in the town of Williamson, about eight feet; at Sodus Point, from eighty to one hundred feet. The bank is composed of sand and gravel, with occasional layers of clay. Generally a beach of some width runs along the shore, varying from fine to coarse gravel, according to the state and direction of the winds; it is sometimes entirely swept away by the excited waves of the lake.

Valleys.

In Wayne county, the Erie canal is carried along the valley of the Clyde, from both sides of which the country takes a very gradual rise. Canandaigua, Crooked, Seneca, and Cayuga lakes discharge their waters northwardly into the stream which traverses this valley. The stream is known firstly as Mud creek, until joined by the Canandaigua outlet, when it becomes Clyde river, and so continues eastward as far as Montezuma, where it receives through the Seneca outlet the waters of Crooked, Seneca, and Cayuga lakes, and then continuing east through Cayuga into Onondaga, joins the outlet of Oneida lake, with which it forms the Oswego river. The latter finally empties all the waters of the Clyde and Oneida valleys, including fifteen lakes, into Lake Ontario.

It was suggested to me by Col. Elias Cook of Sodus Point, the present chief engineer on the Sodus canal, that at a former period, and perhaps previously to the formation of the Cayuga marshes, the Seneca river discharged a part or the whole of its waters northwardly through the towns of Butler and Wolcott in Wayne county, along the Wolcott creek* into Port bay on Lake Ontario. An examination of the country renders this opinion very probable. The marsh extends past Crusoe lake, which is immediately north of the island of the same name, into the town of Butler, to within a short distance of Wolcott creek. Also, by the surveys of Col. Cook, it appears that the rock in Wolcott creek at Marble's quarry, (lot 165 in Butler,) is only one foot above the level of the Montezuma marshes. It appears also from other surveys which we have had an opportunity of consulting, that from the north part of Crusoe lake in Savannah, to Marble's in Butler, a cutting to four feet below the water at Crusoe's bridge, will average fifteen feet. This is a distance of about six miles, and the excavations would be through sand and gravel. The extensive water-worn surface of rock in the creek at Marble's quarry, indicates the passage of a much larger body of water than is now transmitted through this channel. At the village of Wolcott, we also notice a large gorge or gulf, produced by the current of a great body of water along the course of the present stream. The creek at present falls over the eastern part of this gulf, and upon no occasion of freshet in the present stream, does the water extend to the other side of the gulf; at the bottom of which we notice the ruins of an old furnace, which was erected for the purpose of working the argillaceous iron ore of the vicinity.

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* Its proper name is Mill creek.

Marshes and Swamps.

The Cayuga marshes occupy a part of the town of Savannah, surrounding both sides of Crusoe island, and extend beyond Crusoe lake into the south part of Butler. These marshes contain a deposit of calcareous marl apparently equal in extent to that of the marshes. The Erie canal is cut through them for several miles, and penetrates the marl to the depth of five or six feet. This contains fresh water shells.

The Cayuga marshes are gradually being filled up, so that part of them are occasionally reclaimed, and put under cultivation. The importance of reclaiming the extensive surface occupied by these marshes has long been understood, and measures were early adopted to effect this object. In 1825 the Legislature appropriated $80,000 for the drainage of the marshes, which was attempted by lowering the bed of the Seneca river in the vicinity of Jack's rift. The river makes a bend at this point, forming a peninsula, and a new channel was cut across the neck of this, by which the bed of the river was lowered some two or three feet, and the level of the Cayuga marshes reduced, as we are informed, about one foot. The success was only partial, and not so great as had been anticipated.

In the same year, 1825, a company was authorized by the Legislature to drain Crusoe lake "by cutting one or more ditches or canals from said lake to Wolcott creek;" and in 1837, some new or additional powers were given to the same company, whose object appears to have been, to obtain enlarged water power upon the creek which passes through Wolcott village. We believe that nothing has been effected by this company. The route or course of their canal, is the same that we have referred to in the preceding remarks under the head of *Valleys*, and is the only one that we consider can be adopted with success for the effectual reclamation of the Cayuga marshes.

A cranberry swamp was noticed at the head of Port Bay, about three miles in length and one and a half in breadth; its shakes, is movable, and at times an acre or more has become detached and floated into the water. Cranberries grow on some parts of it; also rushes and grass. Hay has been made upon it occasionally.

Soil.

South of the ridge the soil consists of a sandy loam, lightest, as the farmers say, on the west side of hills, and strongest and best on the eastern sides. This may be owing partly to exposure, and to the circumstance that the western sides of hills are frequently bared of snow by the westerly winds of winter. Beach, maple and bass-wood generally prevail on the east sides of hills, and hemlock on the west. North of the ridge, the surface is decidedly more sandy; yet in Wolcott and other towns in the south part of the county, the soil is generally productive, the crops are good, and it is a grain growing country.

Mineral and other Waters.

The springs in this county arise chiefly from limestones, from shales and marls, which contain a proportion of lime; of course they are more or less impregnated with calcareous matter. Along the lake, however, the sandstone range furnishes spings of a pure and soft water.

Sulphur Springs.

Several sulphur springs arise in Brown's mill pond, about one and a half miles south of Newark. The water running from this pond deposits sulphur, and sulphuretted water issues from the bank at the road opposite the dam, and forms a whitish deposit. When the water in this pond becomes low, the small fishes which it contains are sometimes found dead, floating on the surface. No other cause than the properties of the sulphurous springs has been assigned for this fact.

On Salmon creek near the forge in Sodus, a weak sulphurous spring rises from the red sandstone and forms a reddish deposit. One or two sulphur springs also occur in and near Palmyra. At Jenkins' hill in the village of Clyde, there was a weak mineral spring, probably of a sulphurous nature. With the exception of that on Salmon creek, all these springs occur in gypseous rocks. About half a mile north-east of Marion Centre, a sulphur spring arises from the bituminous limestone. The place is resorted to by residents of the vicinity, and occasional visiters.

Salt Springs.

The old Galen salt works are situated on lot No. 54 in the town of Savannah, immediately on the western edge of the Cayuga marshes. The spring is large, and is indeed quite a pond—say twenty feet in diameter. Salt was manufactured about twenty-five years since, when the country was new, and but thinly settled.

One or two salt springs formerly appeared in the creek, a short distance below Wolcott furnace; they are now neglected and filled with fresh water. These springs were worked in 1815, and furnished a reddish salt. They arise from the red sandstone. Another salt spring arises from the red sandstone upon a small creek emptying into Sodus Bay, near the point.

Two miles east of Lockville, near the Erie canal, a Mr. Worden bored for salt. There was originally a spring at this spot, and salt was manufactured to a small extent. This is in the region of the Gypseous rocks.

Deep boring for Salt Water at Clyde.

In 1832 a company bored to the depth of 400 feet in the immediate vicinity of Clyde. The spot selected had no indications of a saline or other mineral character, there was no spring, and the boring was commenced in the gypseous rocks. Salt water was obtained in small quantity, but quite strong. A square wooden tube now projects several feet at the spot where the boring was done, but at present the water does not rise to the surface. Gypsum was found at the depth of twenty-five feet, which continued at intervals for 100 feet; below this was found sandstone, and occasional hard layers of rock—towards the last, so hard that the drill gained only an inch per diem. They passed through a fissure at 100 feet. Salt or brackish water appeared at 170 feet. The lowest rocks were sandstone and slates. Inflammable air was discharged during the boring, also subsequently. At the time our visit, on shaking the wooden tube, a gurgling noise could be of heard below, and then upon passing down a burning paper an explosion took place in the tube. Sulphurous, or any other decided odor could not be distinguished. Doubtless this inflammable air was carburetted hydrogen, as it has been frequently noticed in the western states in similar borings for salt. Messrs. Reese and Stowe were of the company who made the search, and from them we received the preceding account of the work; the former gentleman presented us with the only sample he then possessed of the rocks penetrated during this boring, and which was extracted from the depth of 348 feet.

Clay.

Clay, suitable for the manufacture of brick, occurs abundantly along the line of the canal, and in limited beds at several points near to and north of the ridge. In the vicinity of Lyons clay occurs in extensive beds, and is largely employed in the manufacture of brick. Also at Lockville, a marly clay occurs near the surface; it is yellowish, and resembles the gypseous marl immediately below. It forms a soft brick, which does not so well withstand the action of the weather as those made of pure clay. Mr. Bannister, the proprietor of one of the kilns, informs us that the lower part of the bed yields a clay which makes a good fire brick; if so, it differs from that of the upper part of the bed, which contains a little lime, as is shown by its effervescence with acids. About one and a half miles northwest of the Walworth corners, we saw a good brick clay; it is yellowish and does not effervesce with acids. At Williamson corners, just north of the ridge, is a yellowish clay, which also appears to be pure, and has been used for the manufacture of brick. A bed of potter's clay is noticed on the lake shore, near the mouth of Salmon creek.

Sand and Gravel.

Fine and coarse sand, and also gravel, occur in the numerous low ridges in the southern part of Wayne county. Gravel generally prevails upon the eastern sides of the hills, while upon the opposite sides the deposits are finer. An extensive bed of fine white sand was exposed in the excavations for the Sodus canal, in the southern part of the town of Rose.

In the town of Wolcott, about one mile north of the furnace, on the west side of the bay, we visited a deposit of fine sand, gravel and coarse pebbles, all in the same bank or side-hill, about thirty feet above the surface of the bay. The pebbles are rounded, flattened and smooth, coated with a crust of carbonate of lime, and are generally similar to the ridge pebbles, and those on the lake shore.

About Clyde there is such an abundance of pebbles of a dark blue limestone, that they might be collected and burned into lime with profit; this has been done in the county of Alleghany, and elsewhere, at points where limestone does not occur in place. The pebbles appear to be slightly bituminous, but differ from the bituminous limestone which occurs about six miles north, in the town of Rose. They have also a coating of carbonate of lime, similar to that on the ridge pebbles.

Boulders.

Primitive boulders are noticed in abundance in Wayne county, but they do not occur of a large size; they seldom exceed half a ton in weight. Some of them could be distinguished as of similar character to rocks in the northern counties of the State, and among all the erratic masses which I have noticed, none were considered to be of southern origin. A great variety of primitive boulders occur in and about the village of Clyde, also in the town of Butler.

Marl.

In the town of Savannah, shell marl occurs, underlying the Cayuga marshes. This is exposed by the Erie canal, where it passes through the marsh, to the depth of several feet. It is white and earthy, and contains abundance of fresh water shells, of the genera Lymnea, Physa, Planorbis, Valvata, &c. and is covered by vegetable mould and peat. I was informed by a farmer on the east side of Crusoe Island, that the marl was met in digging at the edge of the marsh.

One mile west of Newark, a bed of shell marl appears in the banks of the Erie canal. It is whitish, and contains shells similar to the preceding. The depth of this bed is unknown, but it is probably small. It extends about one mile along the course of the canal.

In the south part of the town of Williamson, at Cooper's swamp, is a thin bed of whitish marl, containing shells similar to the preceding.

The calcareous marl above mentioned consists principally of carbonate of lime, with a little vegetable matter, and is in an earthy or friable state, perfectly adapted to employment as a manure. We are not aware, however, that it is at present applied to any useful purpose; but we conceive that it is equal in value to our western plaster, and may be a better application to some lands. We would suggest to the intelligent farmers in the vicinity of the Cayuga marshes, who may penetrate this marl in the course of ditching, to make a comparative trial of this article with the neighboring plaster.

Gypseous Marl.

Plaster marl (the local name) occurs at many points on the Erie canal, and extends south into the adjoining county of Ontario. It generally appears as a soft slaty rock, or as an indurated marl, of an ash gray, and sometimes a greenish colour. It is the gangue of the gypsum or plaster, in this, as well as in the neighboring counties. This marl generally contains an appreciable proportion of lime, although in some instances it is entirely argillaceous. Although of the nature of rock when first extracted, upon exposure to the air it slackens and crumbles down in a short time. We are not aware that it is used as a manure, but without doubt to sandy soils its addition would be very profitable, perhaps as much so as the plaster which it affords; inasmuch as soils purely sandy require clay as well as lime to give them a proper character of composition.

Near Clyde, the gypseous marl occurs, of a dark gray colour, slaty structure, and contains marine fossils, among which are Orthocera, Trilobites, and a variety of shells.

At Lockville, one mile east of Newark, it occurs, greenish, reddish, and variegated, in the banks of the canal, and in various excavations, especially at a race-way from Price's mill. At the latter place I examined and collected the marl. The greenish variety occurs amorphous, and contains gypsum in irregular or curious crystals. It effervesces with acids. Another variety is slaty, gray or ash colour, soft, penetrated by numerous very thin seams of gypsum, and does not effervesce with acids. It appears to be entirely argillaceous, slackens upon exposure to air and moisture, and crumbles to a dry earthy powder.

The crystals referred to above, as occurring in the greenish marl, are somewhat in form like the hopper shaped crystals of salt; they appear like cubes which have a thin lateral expansion from each edge of the crystal, which expansion frequently exceeds the diameter of the central crystal. Both surfaces of these expansions are transversely striated, and inclined at an angle of 135° to each surface of the central cube. The planes of the central cube are slightly concave, but not striated. The impressions of these striated crystals have been frequently noticed in the gypseous rocks of Onondaga, Monroe, and other western counties; but at most localities the original crystals have disappeared, and the rocks present only their cavities, the walls of which are curiously striated. These cavities are also sometimes lined with small transparent rhombic crystals of gypsum.

Bog and Argillaceous Iron.

Bog Iron.—About one mile east of Lockville, on Howser's farm, we collected some fine bog iron. It covers about an acre; occurs in large solid masses near the surface, and is frequently turned up by the plough.

Argillaceous Iron.—A stratum or bed of argillaceous oxide of iron extends through Wayne county, parallel to and at the distance of about two miles from the lake. Furnaces for the reduction of this ore have been constructed in the towns of Wolcott, Sodus and Ontario. It has been ground for paint, and hence receives the name of paint ore. It belongs to the *lenticular* variety of mineralogists. It is always accompanied by greenish argillaceous shales, and thin layers of shell limestone, and the ore itself appears to be composed chiefly of marine shells and other fossils, similar to those in the shales and limestones above and below.

Wolcott furnace is situated about one mile north of the village, upon a small creek which empties into Port Bay. Argillaceous iron occurs in the immediate vicinity of the furnace, but is only one foot in thickness, and intermixed with slate and limestone, on which account it is not at present explored. The furnace is supplied from the ore bed of Black creek, situated on lot 41 in the eastern part of the town, and six miles distant from the furnace. The ore at this bed is three feet in thickness and of a good quality.

After removing about 10 feet of sand and clay, the ore appears, covered with a layer of slate. There are two layers of the iron, which together make a thickness of three feet. Small rounded masses of compact limestone occur in the iron, and also a peculiar reddish mineral. This ore contains many fossils, including species of Producta, and other bivalve shells, and remains of Encrinites and Zoophytes. The argillaceous iron generally constitutes the substance of the fossils, though in some instances the calcareous matter of the shells remain.

The argillaceous ore makes a hard, brittle iron. When melted without any flux, it is too sharp, i. e. the cinder is equally as fluid as the iron, from which it does not separate, but will sometimes run to the end of the mould. The melted mass is too thin, and therefore it is necessary to mix loam with the ore. At the Wolcott furnace, Mr. Hendrick uses one part of sandy loam to two parts of ore, upon which the cinder separates, and perfect castings are produced. Mixed with the rock ore, or magnetic oxide from Canada, in equal parts, and also in the proportion of two parts of argillaceous to one of magnetic ore, a softer and better iron is produced.

The argillaceous oxide requires a high heat for melting, and consumes one third more charcoal than the harder ores. There is always produced considerable carburet of iron in thin bright scales or leaves, exactly resembling plumbago; we have also seen this substance formed from the magnetic ores of iron at a high heat.

When casting plough irons, they run them upon a *hardener*, (which is a piece of cold iron) so that for two inches or so on the edge, which is liable to wear, the castings are hardened like steel. The effect is, to change the usual granular texture of the casting into one that is lamellar, like Bismuth. This difference is perceptible, and the line of demarkation is also very evident when the casting is broken.

In 1836, at the Wolcott ore bed, there was raised 600 tons of the argillaceous ore, and Mr. Hendrick considers that it furnishes about 33 per cent of iron. To this gentleman we are indebted for most of the facts and statements mentioned above in connection with the Wolcott furnace.

The stove, plough, and other castings, hollow ware, &c. manufactured at the above establishment, appear to be of an excellent quality.

The argillaceous ore of iron occurs on lot 339, in the town of Huron, but is not at present explored.

In the town of Sodus, the bed of argillaceous iron was worked near the mouth of Salmon creek, upon which the old forge is still standing. The ore is not so pure as at Wolcott. It occurs in several layers in connexion with limstone and slate, and contains abundance of fossils, among which were noticed Retepora, Cyathophyllum, Crinoidal joints, Leptæna depressa.

Ontario furnace is situated upon Bear creek about two miles north of the ridge. The argillaceous ore of iron is extracted in two places in the immediate vicinity of the furnace; it is a continuation of the same stratum that is explored in the towns of Sodus and Wolcott. The layer of iron ore is situated about 50 feet above the surface of Lake Ontario. Solid ore occurs with a thickness of about three feet, and to a greater extent mixed with rock; it is clean, of a bright red colour, exhibits its fossils very distinctly, and its characters are generally similar to those of the Wolcott ore. It is said to yield from 33 to 35 per cent of metallic iron. The iron which it forms is brittle, and is employed for large castings, as potash kettles, ploughshares, &c. Bog ore improves it. The ore is quarried and delivered at the furnace for $1.50 per ton. There were formerly manufactured at this furnace 300 tons of iron per annum. This ore was first dug during the last war, carried to Auburn, and ground for paint, of which it is said to form a good article with the addition of a little red lead. The establishment belongs to Henry S. Gilbert, Esq.

Quicklime.

A range of limestone runs in an east and west direction across Wayne county through the towns of Butler, Rose, the lower part of Sodus, Marion and Walworth, upon which are situated a line of kilns, which furnish an ample supply of lime of an excellent quality. The limestone is frequently of a dark colour, and contains bitumen, which is, however, expelled in the process of burning, and a white lime is produced.

Hydraulic Lime.

We consider that the materials for the production of water-cement occur in this county, although they are not at present explored. One mile south of Newark there occurs a gray sandy limestone of a slaty structure, which resembles the hydraulic limestone of Onondaga county. Also, in the south part of Williamson appears a slaty, siliceous limestone, similar to, and in the same range with the hydraulic limestone of Monroe county. The Williamson rocks are immediately under the bituminous limestone presently to be mentioned under the head of building stones, while those near Newark are above it, and also superior to the gypsum. A similar rock occurs at Merrick's mill on Van Awken's creek, in the town of Rose.

Firestones.

Limestone containing an abundance of shells and other fossil remains is generally employed in this county for hearth stones, and in other situations exposed to frequent changes of temperature. Such were noticed at Merrick's mill, in the town of Rose; in the town of Sodus, south of the *ridge*, and in other parts of the county, in the range of slates under the bituminous limestone.

The sandstones of Beard's creek and Little Red creek, in the town of Wolcott, endure the action of heat sufficiently well to answer for side stones of furnaces, and they are employed for that purpose at Wolcott. When exposed to a red heat, and beyond, they do not swell or expand, on the contrary, they appear to contract, so that when used for the hearth, the temp stone (which is like the key stone of an arch) has sometimes fallen out.

At present, at the Wolcott furnace, they use and approve of the Oswego stone, viz: the red sandstone of Oswego falls, which is a part of the same formation as this in Wayne. The Oswego stone swells or expands upon being heated, and is therefore well adapted for hearth stones.

At the glass-house in Clyde, they have employed the Haverstraw sandstone, but at present they use, in preference, the stone from Perryopolis, Penn., and from Vienna, Ontario county.

Building Stones.

The range of limestone that we have referred to under the head of quicklime, passes through this county about midway between Lake Ontario and the Erie canal, in an east and west direction, having a width of from two to three miles. Many favorable situations occur for the extraction of building stone of an excellent and durable nature. This rock varies in colour from a light to dark blue, is of a granular texture, sandy, and emits a bituminous odor on percussion. It occurs in layers, of from one to three feet in thickness, having a horizontal position, and an elevated and dry situation. We noticed two quarries near the line of the Sodus canal now in progess, and which belong to the company constructing said canal.

Uttoe's or Miner's quarry, lot 132 in Rose, is on the head waters of Sheldon's creek. The rock occurs in extensive layers, two or three feet thick, of a dark blue colour, granular texture, and highly bituminous. This quarry has furnished an approved stone, which was employed in the locks of the Erie canal, at Clyde.

Henderson's quarry, lot 141 in Butler, affords large blocks of a building stone, similar in all respects to that last mentioned.

Roe's quarry, in Butler, furnishes a dark compact limestone, which is bituminous. It is employed in building, and also for the manufacture of lime, of which it affords an article of excellent quality. It is a magnesian limestone, and contains only a few fossils, among which we recognise Cytherina.

A compact shell limestone which occurs near the Shakers' mill in Sodus, is quarried out as a marble, and used for ornamental purposes. It is so employed at Geneva.

The range of sandstone in this county is narrow, not exceeding two miles in width, and lies immediately along the lake shore. It does not appear to be used for architectural purposes; indeed, it is too soft, slaty, and argillaceous, except in the town of Wolcott, where the upper layers are hard, siliceous, and occasionally pass into conglomerate or pudding stone. These upper layers have been quarried and used in the construction of furnaces, as at Wolcott. (See article Firestones, p. 324.) At the forge on Salmon creek, the sandstone contains abundance of the Fucoides Harlani.—(Conrad.)

Gypsum.

The range of gypseous rocks extends on both sides of the Erie canal, along the southern part of Wayne county, but generally lies too low for profitable exploration. At Clyde they meet gypsum in wells at the depth of 25 feet. Wells at Lyons have struck plaster at 40 feet, and also in Palmyra, at about the same depth.

About two miles west of Newark, on lots 84 and 85, are two hills, one on either side of the Erie canal, from which gypsum is quarried, and principally on lot 85, owned by Winslow Heth. The gypsum at this locality is mostly lamellar, transparent, and is of that variety which receives the local name of isinglass plaster. It is sometimes reddish, and rarely crystallized; it is mixed with or disseminated in a calcare ous or argillaceous marl. Several varieties of gypseous marl occur here, slaty, green, red, and variegated. The reddish Selenite occurs at the lowest point in this hill, and was taken from the reddish or variegated marl. This quarry was opened seven years since, and from 2,000 to 3,000 tons have been extracted. It occurs in large, rounded, irregular masses. Sells for $2.50 to $3 per ton. Blackmar's quarry is immediately opposite, and on the south side of the canal. The plaster is of the same quality as at Heth's quarry.

A considerable proportion of the gypsum at Heth's quarry is transparent, and consists of leaves or laminæ. This variety also occurs at the plaster beds in the neighboring counties, associated and mixed with the granular, compact, or slaty gypsum, and is generally known by the local name of *Isinglass Plaster*. A strange prejudice prevails with regard to this variety, which in some places also extends to the *fibrous* gypsum. It is consideredan *impurity*, and to be injurious as a manure, and consequently those masses which contain it are excluded and thrown aside. This opinion is entirely erroneous, for the transparent and fibrous varieties are a purer article than the opake, granular or compact forms of gypsum, and their transparency is occasioned merely by their crystalline structure. Nearly one half of the Nova-Scotia plaster consists of the transparent, lamellar, and fibrous varieties, which have been excluded at these quarries as an impure article.

We take this occasion of presenting our acknowledgments to James R. Reese and Wm. S. Stowe, Esqrs. of Clyde, to Col. Elias Cook of Sodus Point, to Dr. —— Williams of Newark, and to Levi Hendrick, Esq. of Wolcott. To the above gentlemen we are indebted for personal attentions, and for much valuable information and assistance rendered to us during the examination of Wayne county.

LOCAL AND ECONOMICAL GEOLOGY.

MONROE COUNTY.

Surface of the Country, Streams, &c.

The general elevation of the northern part of this county is about three hundred or three hundred and fifty feet above Lake Ontario.—All that portion of the county south of the canal maintains about this elevation, if we except the diluvial hills, which rise to the height of from fifty to one hundred feet. On the north of the canal the surface declines gradually, and almost imperceptibly, to the lake shore; on the east side of the Genesee it is more uneven than on the west. In the northern part of the county, particularly north of the ridge road, the surface is remarkably even. We here find scarcely an undulation or depression disturbing the uniformity, except the channels of the present streams.

East of the Genesee, particularly in the vicinity of the Irondequoit creek and bay, the country is very much broken into deep ravines and high ridges. These ridges or hills are composed chiefly of fine sand, or sandy loam, with strata of pebbles or boulders near the bottom. Most of the boulders in these hills are from the rocks in the vicinity, those of the primitive rocks being comparatively few in number. In this and some other respects the diluvium along the Irondequoit differs from that of any other part of the county. There have been vast accumulations of diluvial matter about the head of Irondequoit bay, and along its shores. It appears as if at one time this had been a great water course, and that some inundation of sand, gravel, &c. had filled it up and changed the direction of the stream. The sand of these hills is stratified, and the strata often curved, or inclined at different angles. The banks of the bay are high, with deep ravines scooped out by the action of the smaller streams.

The bed of the Irondequoit at Penfield, is much lower than the bed of the Genesee at Rochester and farther south. From examining the surface of the country this seems the most natural course for the Genesee, and it may at one time have flowed in this channel. The Irondequoit is now a small stream, pursuing its course in a deep valley of denudation, showing that some more powerful agent was formerly active in this quarter.

Farther south and distant from the streams, through the towns of Penfield, Perrinton, Mendon, &c. the diluvial hills are of moderate elevation, giving a gentle undulating appearance to the country. In the south part of Perrinton the surface is very irregular, the hills rising from fifty to one hundred feet above the general level. These hills are composed of gravel and hardpan, and the general character of the soil is gravelly. Some of the hills are sandy, supporting a growth of shrub oaks and whortleberry; the soil, however, is said to be good when reclaimed. West of the Genesee few hills rise to a greater height than thirty or forty feet. All the hills in this part of the county rest upon the gypseous formation, and many of them are formed by the destruction of the upper portions of these strata.

Most of the streams afford eligible mill seats, and it is to the water power furnished by the Genesee that Rochester owes much of her prosperity. The great accumulation of water power at that place, depends on the geological structure of the country. Had all the strata been of equal hardness, the grand and beautiful succession of falls and rapids would not have been produced, but in place of them a uniform rapid current to the lake.

The mountain ridge, or "limestone ridge," so called, becomes well defined a few miles west of Rochester. Here its elevation is only fifteen or twenty feet, but it gradually rises towards the west, and at the western line of the county is forty or fifty feet above the level of the country on the north. This ridge or terrace does not pursue a direct line, but is tortuous and irregular in its course.

The streams in this county, west of the Genesee, all flow in a northeasterly direction. I have not been able to find any cause for this in the structure or surface of the country.

The general direction of the ridges or diluvial hills in the south part of the county is N. E. and S. W. To this course there are a few exceptions. Along the river and the Irondequoit bay, the course of the ridges is more irregular, and we find them ranging in every direction. The highest of these hills in Monroe county is the "Pinnacle," about two miles southeast of Rochester.

In many places we find swamps or marshes with large accumulations of partially decomposed vegetable matter, though none of it has yet become peat. The substance is usually termed "muck," and is used in some places as manure. There are several of these swamps along the lake shore, where immense quantities of "muck" are deposited. Others on the south side of the ridge road, exhibit finely comminuted vegetable matter, with trunks of trees, deposited often to the depth of several feet.

The trees growing in these swamps are commonly black ash, tamarack, and cedar. In the southern part of the county are several swamps of this character, where the vegetable matter covers a deposit of shell marl —both substances of great value as manures.

Lake Shore.

The lake shore of this county is for the most part low, the land gradually declining to the level of the water. The action of the waves, together with the ice, have raised beaches, which in many places protect the land from inundation during high winds. In the eastern part of the county, the banks are abrupt, consisting of gravel, sand and clay. These banks are gradually worn away by the waves, and the materials carried to points where the banks are low. By this wearing action the lake encroaches upon the land in some places, while the land is gaining upon the lake in others. In the course of a year, several feet of these banks are abraded by the waves. During some years, the lake is higher than in others, so that the wearing action is not uniform. The wind from the northeast carries the abraded materials towards the mouth of the Genesee, and thus aid in filling up the channel, and extending the shoals and sand-bars in the vicinity. The shores being low on the west of the Genesee, a west or northwest wind brings few materials from that quarter. When the lake is higher than usual, even the low beaches are worn down, and the materials transported to other parts of the shore.

The bank of the lake, from the Genesee river to the eastern boundary of the county, is from ten to thirty feet high. From the Genesee to the western line of the county, the shore is generally low, or raised into a beach a few feet above the lake. For the last two years the lake has been higher than for many years before; this is evidenced by the waves undermining the banks which had become overgrown with trees and shrubs. There is a tradition of a periodical rise of the lake, but it is not verified by observation. Although this rising of the lake is not periodical, it does occur at intervals, and at such times the beaches and sand-bars are removed, to be deposited in other places, and to fill up the mouths of streams. It therefore becomes a matter of importance to protect the shores from such effects, and from the loss of land thus sustained. To do this, trees and shrubs should be permitted to grow on the banks, and shrubs with strong roots might be planted to effect the same object.

The Irondequoit bay is so situated, that it receives the abraded materials of the banks of the lake, from both the east and west. This bay is about one mile and a quarter wide, gradually narrowing southward;

it is separated from the lake, except a narrow outlet, by a sand-bar or beach from fifty to two hundred feet wide, and rising from three to twenty feet high. The outlet was originally on the eastern side of the bay, and with six or seven feet water, admitting the passage of sloops, which were freighted at the head of the bay. It is now through the beach one quarter of a mile west of its original location, and has but three feet depth of water. The greater part of this beach has accumulated within the last fifty years. At that period it was very low, and scarcely covered with grass, and is now overgrown with large trees.—The sand and silt brought down by the stream into this bay are gradually filling it up, and eventually it will become a marsh, with the stream winding through it to the lake. The low beaches west of the Genesee river present a miniature analogy to the lake ridge; having accumulated before low or marshy grounds, they slope inland as well as towards the lake. Till within two years, the beaches along the lake shore in this part of the country have been increasing in number and magnitude. The landing of trees, roots, &c. along the shore, forms the nucleus around which pebbles, gravel and sand gather, and produce a ridge, or continuous beach. In this manner the outlets of streams are barred, until the accumulation of water becomes sufficient to force a passage into the lake. During the time that the outlets remain closed, the sand and silt brought into these ponds or marshes are quietly deposited in the still water. A process is thus going on which will eventually reclaim these extensive tracts, and make them some of the most fertile soils in the county. By this process, we see how these marshes, now below the surface of the lake, will be elevated above it. The bars at the outlets raise the water to a greater height than the level of the lake, and the deposits made at this time may and finally will accumulate to a higher level than the lake. The outlets of Long-pond, Buck-pond and Round-pond, have been barred up, and the water has accumulated so that the three communicate with each other, and the water of the whole is sufficient to keep open an outlet.

The similarity of the lake shore to the lake ridge is in many places very obvious. In one place four parallel ridges at no great distance from each other, extend for half a mile. The tops of these ridges are from eight to ten feet above the lake; they are composed of sand and pebbles, covered with a sandy loam or sand. Large trees of oak, elm, beech and button-wood, grow upon these ridges, showing that they were formed at least one hundred years since, while the same cause is now active, producing similar ridges before our eyes. It is unnecessary to give the detail of the operation of these causes at the outlets of all the streams; they are the same in all.

Boulders—Erratic Blocks.[*]

Boulders of different rocks are abundantly distributed over some parts of the county. They are perhaps most abundant north of the mountain ridge, and over the gypseous rocks in the south part of the county. In many places the surface is literally covered with them for a considerable extent, and again for a mile or two few are seen. These boulders are of the primitive rocks, as granite and gneiss, and of sandstone from the lower formation. In some cases we meet with pebbles or boulders from rocks farther south. Granite and sandstone are the prevailing boulders, but rounded and angular fragments of rocks of every formation, in the district, are found on the surface, some of them immediately above the original rock, and others at no great distance from it. The predominance of feldspar is observed in all the granite boulders; many of them being of that variety called Labrador feldspar. This feldspar is very indestructible, and masses of that rock form some of the largest boulders in the county. Some of the spherical masses are eight or ten feet in diameter. These masses are in many places so abundant as to be broken up and used for building materials, for which purposes they are very durable.

Soil.

The prevailing soil of Monroe county is a gravelly loam, but we often find clayey loam, sand, &c. extending over considerable areas. Approaching the Genesee river on either side, the soil is more sandy; this character prevails, also, along the Irondequoit. Sometimes the different soils blend into each other, and at other times are quite distinct, or their limits are defined by the small streams. Sometimes changes of this kind are remarkable, where on crossing a stream the character of the soil is entirely different. The sandy soils are not deficient in carbonate of lime, and the sand from several feet below the surface is apparently as fertile as the original soil. Some of these sands require the addition of alluminous matter to render them of proper consistence for retaining moisture.

Where there are no disturbances in the surface from streams or other causes, the character of the soil depends much upon that of the rock beneath; but owing to causes of disturbance in many places, we cannot depend on this criterion. The upper strata of the sandstone produce a sandy soil, but its character is modified by the decomposition of the shales above, which generally supply sufficient aluminous matter. The marl of the sandstone formation below the upper strata, produces a loamy soil, in some cases approaching to clayey loam. Sometimes this soil is mixed with gravel or sand, and no one kind prevail over an extensive district. It is no uncommon occurrence to find, in the same field, sandy, clayey and gravelly soil. The soil on the north side of the lake ridge, for the most part, is more uniform in character than on the south. That on the north side requires more care and labor in the cultivation, but is thought to produce quite as good crops as the soil on the south side. Wheat, in some instances, has been sown on these soils ten years in succession. The soil above the sandstone has often a brownish colour, arising from the character of the rock beneath.

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[*] We cannot, with propriety, restrict the term boulder to a rock distant from its original formation; for in the southern part of the State, rounded masses of the red sandstone are boulders; while masses of the same form are found on the limestone a few rods south, and in the soil above the original rock, which by that definition are not boulders.

The shales above the sandstone produce a clayey soil, which, however contains a sufficient quantity of carbonate of lime to render it extremely fertile. The soil produced by the decomposition of the calcareous shales, north of the mountain ridge, is perhaps the most productive of any in the county. It is peculiarly adapted to the growth of wheat.— If tilled for a long time, and particularly if worked while wet, it becomes " stiff," and hard, like clay.

The soil upon the limestone, is from a few inches to twenty feet in depth, of a loamy character, and very fertile throughout. The slow disintegration of the limestone affords a sufficient proportion of carbonate of lime, and if vegetable matter be also furnished, the soil will not soon be exhausted. In the southern part of the county the soil is gravelly or sandy on the hills, and clayey in the valleys and low grounds. The soil of this part of the county contains a large proportion of carbonate of lime, arising from the decomposition of fragments of slaty limestone which are distributed throughout. In some places in this part of the county we find extensive deposits of coarse gravel, with boulders. In the southern part of Monroe county, the soil will bear cropping for a great length of time, without the use of manure.

Clays.

The clays of Monroe county are of that kind, fit for bricks and the coarsest kinds of pottery. The varieties are gray, blue and brown clays; gray and blue varieties prevail along the lake shore. Those in the interior of the county are brownish or variegated. Every part of the county furnishes beds of clay of greater or less extent, but the demand for bricks has been limited to a few points. As many as five or six beds of clay have been wrought in the vicinity of Rochester, from which about 2,000,000 of bricks are furnished annually. Bricks have been made near the village of North Penfield, and there is an extensive deposit of clay on the lake shore in the north part of the town of Brighton. Bricks are made near Fairport and at Mendon and Pittsford. Beds of clay occur near Clarkson and Brockport; from some of which bricks have been made. We might enumerate every town in the county, but the materials are similar and are found in all.

Clays might be used, to manifest advantage, on some of the sandy soils, particularly in the eastern part of the county, where the same farm often contains both sand and clay.

The decomposing gypseous marls appear at the surface in Pittsford, and other places, where they have been mistaken for clay. This marl contains too much carbonate of lime to be useful for bricks, but would be valuable if used as a manure on sandy lands. It makes bricks of a very inferior quality, which crumble on exposure to rains, and are peculiarly unfit for exposure to water.

Sands.

The only pure siliceous sands we find in this county are on the lake shore. With these garnet and iron sands occur in small quantities.—Coarse sand or fine gravel, fit for making mortar, is found in many places, particularly along the Irondequoit, and in many of the diluvial hills. The fine sand of the diluvial hills contains too much aluminous matter to be useful where a siliceous sand is required. At the outlet of the Irondequoit bay great quantities of a pure siliceous sand is drifted into ridges along the shore. Sand may be obtained from this place, in sufficient quantities for the manufacture of glass, or for sawing marble, should it ever be required for such purpose. This kind of sand is found at intervals, and in great quantities along the lake shore from the Irondequoit to Sandy creek. Magnetic iron sand and garnet sand are also found in considerable quantities, and collected for writing sand. The iron is not in sufficient abundance to be of importance as an iron ore. These two sands result from the destruction of granitic rocks containing both iron and garnet.

Water and Springs.

All the water of the county, and indeed of the whole district, contains muriate of lime, being what is termed hard water. The county generally is well watered, though in some parts water is not so readily obtained. Along the northern slope of the "mountain ridge," and over the whole of the sandstone formation, water is abundant, either rising to the surface in springs, or collecting in the low grounds and forming small streams. In digging wells, where the sandstone approaches the surface, it is often necessary to penetrate the rock a few feet before a constant supply of water is found. After ascending to the top of the limestone, water is not so abundant. Few springs rise to the surface, and the water accumulating in the low grounds and forming small streams, is dried up in summer or lost in the fissures of the rock. Consequently, at such seasons the supply of water on the surface is very limited. Water is obtained by digging, at different depths; sometimes at the surface of the limestone, but commonly by penetrating it a few feet. Sometimes in digging wells the limestone is penetrated thirty or forty feet. In these cases it is usual to find a cavity or fissure in the rock, which affords an abundant supply. The water from the wells never overflows the surface, though from the dip of the rocks it might probably be made to do so. The water all flows into wells from the north, as we would expect from the dip of the strata, and in some cases a well dug to the south of one already supplying water, will drain the latter entirely. In such cases, it is only necessary to excavate the northern well deeper to obtain a supply.

The southern part of the county is plentifully supplied with water, both from springs and streams, though towards the northern limit of the gypseous marls it is often necessary to penetrate these rocks to the depth of fifty or sixty feet, and in some instances to two hundred and even three hundred feet, before a supply is obtained. The earthy or compact portions of these rocks affords but little water, till penetrated to considerable depths; and when it is obtained it appears to flow from a cavity or reservoir in the rock. As the rock consists of alternations of shale and compact marl, it is often necessray to penetrate, first a thick stratum of the marl and then one of the slate, and when we come again to the compact marl the water is obtained. The latter stratum in these cases is impervious to water, while it readily percolates through the slaty portion.

Springs of hydro-sulphuretted water are of frequent occurrence in almost every part of the county, but more particularly along that portion occupied by the shales, both above and below the limestone. Some of these springs are celebrated, and are much resorted to by invalids and fashionable visiters. Among these may be enumerated the Monroe springs, about five miles from Rochester, pleasantly situated in a grove not far from the road leading from Rochester to Pittsford. On this road, half a mile from the springs, the proprietor has opened a hotel, where visiters will find excellent accommodations. There is also a fine spring of this kind in Ogden, situated near the centre of the town, which is one of the pleasantest villages in the county. With Mr. Landon, the proprietor, visiters will find hospitality, and every attention conducive to comfort and pleasure. This spring rises from the limestone, about thirty feet below the surface. The place was formerly a well, but failing to yield a sufficient supply of water, it was penetrated to this depth, and is now a perennial spring, but unfit for ordinary purposes. The taste of this water indicates the presence of one or more salts, which renders it rather agreeable than otherwise.

There is a copious spring of this kind, rising to the surface, on the land of Timothy Colby, in Ogden.

The Riga mineral springs are considerably known, and are said to be very beneficial in some cases of cutaneous diseases, and in liver complaints. These springs rise from near the junction of the limestone with the gypseous rocks above. Inflammable gas (carburetted hydrogen) rises from this spring in sufficient quantities to supply a constant flame from a half inch tube. Iron is an ingredient of the water, as appears from the tests applied, and the presence of some salt is indicated by its taste. The rock from which the spring issues is a dark green gypseous marl.

Several hydro-sulphuretted springs issue from the shale along the Genesee below Rochester, but none of them are very copious. The Messrs. Longmuir, at Rochester, have obtained a copious spring of this kind, by boring through the limestone into the shale below. This spring is much frequented, both for the purpose of drinking the water and for bathing. Similar springs may be mentioned in every town in the county.

Many springs contain large quantities of carbonate of lime in solution, which, as the water comes to the air, is deposited in the form of tufa, or a fine pulverulent marl. Where the quantity is small, it forms the porous vesicular deposit called tufa; but where the water is abundant, or where the spring rises in a level tract or swamp, the deposit is marl. The most copious spring of this kind is in Caledonia, Livingston county, though the deposit is chiefly made in Monroe county. There is a similar spring at the source of Mill creek. After the carbonate of lime is deposited, the water of these springs is nearly pure, with the exception of a little muriate of lime. The deposits from these springs will be mentioned under tufa and marl.

Salt Springs.

There are several salt springs in the county, from which salt has formerly been made, but they have been abandoned since the facilities of transportation have increased; and salt is now obtained much cheaper from Salina than it can be made from these springs. None of them appear to have been penetrated to a great depth, and in their present state are so much diluted with fresh water, that in many of them the saline taste is barely perceptible. Owing to this circumstance, and to the impossibility of obtaining accurate local information, no estimate can be formed of their value. All these springs appear to have their origin in the indurated marl of the sandstone formation. Whether the decomposition of this marl affords muriate of soda, I am not prepared to decide; but we know that this mineral does result from the decomposition of the shales above the sandstone. The shale along the Genesee below Rochester produces muriate of soda and sulphate of magnesia.

The water from these springs is of variable purity, in some cases more than half the solid matter obtained by evaporation being of other salts than muriate of soda. In some places the water has increased in strength as the depth has increased, but accurate examinations have not been made of sufficient extent to warrant the conclusion that this is always the case.

The first salt spring which I observed is in the town of Penfield, on the land of Mr. Greig. Salt was formerly made at this place, though the supply of water appears to have been very limited. At present the spring is full, but very little escapes; the surface immediately about the spring is destitute of vegetation, and covered with an efflorescence of muriate of soda. Near the head of Irondequoit bay is another spring, from which salt has been made. On the bank of Salmon creek, in Clarkson, two miles north of Ladd's corners, are three springs in the immediate vicinity of each other. At this place the sandstone or indurated marl approaches the surface. Six miles north of this place, salt springs occur on the land of Mr. Baxter. Salt was made at both these places fifteen years since. Salt springs are of frequent occurrence along almost all the creeks or small streams, and salt licks are found in many places.

The situation of the salt springs in Monroe county, is unfavorable to large accumulations of water, and this may be the reason why they have not been more productive. Those which I have observed are along the margin of small streams, and the salt water as it comes to the surface is carried off by the fresh water, or becomes too much diluted.

Tufa, Marl, and Materials for Manures.

The substance usually denominated marl, is a calcareous deposit from springs, but partially decomposed. Calcareous shales are properly marls, and will be so considered.

Rain water has the property of dissolving the calcareous rocks over which it flows, but the water of many springs dissolve much more. This property is owing to the presence of carbonic acid gas in the water; when the acid is dissipated in the atmosphere, the calcareous matter before held in solution is thrown down. The loose, porous portions of this deposit, usually containing incrusted plants, leaves and other substances, is called tufa; the more compact parts are called Travertin. Besides these, a portion of the deposit in some situations is of a fine pulverulent texture, often containing great numbers of the shells of *Cyclas*, *Lymnea*, *Planorbis*, &c. and sometimes a great proportion of the deposit is made up of fragments of these shells. This substance is usually termed shell marl, though in many of the deposits the shells are almost entirely absent. When the deposit is made in a swamp, or beneath water, it assumes the fine pulverulent texture; but when exposed, or when the deposition is disturbed, it forms tufa. Tufa is also formed in small quantities, in hundreds of localities, where shell marl is not found.

Wherever the calcareous rocks are exposed, the action of rain, and the percolation of water from the soil produce depositions of tufa. Along all the streams and rivers where calcareous rocks form the banks, we find deposits of tufa collecting, and remaining attached to the rock, till, from their increasing weight, they fall into the stream.

Along the Genesee river, below Rochester, are considerable accumulations of this substance. Vast quantities of calcareous matter are also carried down this river and smaller streams, to be deposited in Lake Ontario, probably in much more extensive beds than those found on land.

Tufa is mostly used for burning into lime, of which it affords a fine quality. The more compact parts of it have been employed for building, and form a cheap and durable material. When first removed from the ground, and while moist, it is easily cut or sawed, and is thus shaped into blocks of any required dimensions. After exposure the moisture evaporates, and it becomes very hard.

Deposits of shell marl are found in various places in Monroe county. The most important locality is in the southern part of the county, along the course of Allen's creek in Wheatland. The eastern part of this deposit extends southward into Livingston county. Tufa forms the upper portion of this deposit in many places to the depth of three or four feet, and below it is the shell marl three or four feet thick. Some portions of the formation are nearly pure carbonate of lime, containing abundance of the shells mentioned: in other places it is impure from admixture of earthy matter. It extends, in length, about three miles, and in breadth from half a mile to one mile. The general thickness is about five feet, though often much greater. At its smallest dimensions, we shall find it 125,452,800 cubic feet, or 2,309,056 loads.

Another extensive deposit of this material is found along the course of Mill creek, extending from its source to Cady pond, and filling the marshes around the pond for the extent of many acres. Its thickness is unknown, but in some places it exceeds three or four feet. Tufa forms in many places in exposed situations along this deposit. In low grounds here, where ditches had been dug, I observed the marl lying on the surface as it was thrown out.* The farmers generally do not appear to be aware of its importance. The soil above these deposits is usually a light, partially decomposed vegetable matter, allowing the water to pass through it, by which means it soon becomes parched, and the crops perish. By spreading on this soil a small quantity of clay or loam and the marl beneath, it could be made of the finest quality.

In the town of Riga, on the land of Mr. Knowles, a deposit of this marl of unknown depth, covers thirty or forty acres. It has been penetrated ten or fifteen feet without finding its termination. The upper portions are very pure carbonate of lime, yielding lime of a very superior quality. It is cut out, while moist, in masses of the form and size of bricks, and laid in the kiln and burned. After penetrating this deposit about two feet, it becomes mixed with sand and other impurities, rendering it unfit for lime, but not for manure. By accident, several loads of this marl were deposited and remained for several years on a barren piece of ground; afterwards this spot was ploughed, and has yielded large crops every year since, though before it produced almost nothing. Strange as it may seem, this change in the character of the soil was not attributed to the marl, consequently it has not been used on other parts of the farm. Numerous other locatities have been noticed, but these are the most important. Those enumerated are upon the gypseous rocks, and similar deposits may be expected in the low grounds throughout the whole of this formation, the extent of which may be learned by referring to the description.

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* The source of this stream is a spring rising among the gypseous rocks. The spring in Caledonia, Livingston county, is the source of the stream from which most of the marl of the first named locality is deposited.

In several places east of the Genesee, in Monroe county, this marl has been found in small quantities. The gypseous formation on that side of the river is mostly covered with diluvial hills.

Small deposits of tufa and shell marl are found along the country north of the mountain ridge, arising from the decomposition of the calcareous shales above the sandstone. Some of these deposits are of sufficient magnitude to supply one or two farms with this article for manure for a great period of time.

From the texture and composition of these shales and of the gypseous rocks, they are more readily dissolved than the solid limestone, and it thus happens that little tufa or marl is found on the limestone proper. Among the gypseous rocks, the process constantly going on to form sulphate of lime, liberates large portions of carbonic acid, and this is doubtless the cause that deposits of marl and tufa are so much more extensive in this formation.

The partially decomposed calcareous shale above the sandstone affords a good manure for sandy lands, but contains too much clay to be advantageous on lands which already have that substance. This shale in many places contains iron pyrites, which, by its decomposition, produces gypsum. This is found from experiment to be eminently useful on sandy soils. All the shale readily crumbles into fine particles, and in this state could be spread on the soil, where its more complete decomposition would be effected by the atmospheric agents, and during the process, the required stimuli furnished to vegetation.

This shale has been quarried at Marshall's mills, in Ogden, ground and used on the soil, under the impression that it was gypsum. At this place the shale contains pyrites disseminated through it, and from its decomposition gypsum would be formed. In many places north of the mountain ridge, the shale approaches the surfaces, and could be readily obtained for manuring lands.

The decomposing gypseous rocks afford a marl, which is sometimes too clayey to be beneficial as a manure, but in other cases it is valuable, especially when mixed with shell marl. This marl approaches the surface in many places in the town of Pittsford, where it is of a character well adapted for use on sandy lands. The same marl occurs also east of Pittsford, along the line of the canal, and at Fairport. Gypsum in small quantities has been found in the marl at these localities. On the west side of the river we find the gypseous marl in Riga, Chili and Wheatland, in some places approaching the surface, or appearing in the beds of small streams. The only place where this marl has been applied is in the town of Wheatland. Mr. Merry has used this and the shell marl, separately and mixed, and finds the results fully to realize his most sanguine expectations. Used on the light vegetable soil of the swamps in that neighborhood, this marl has produced astonishing results. A meadow of this vegetable soil, which produced little or nothing, was dressed with this marl, and sown with timothy seed, and in less than ten weeks from the time of sowing, three tons of hay to the acre were cut from the meadow. The composition of this marl is admirably adapted to fertilize such soils, producing a mixture of calcreous, aluminous and vegetable matter. Without dwelling longer on particular localities, we may observe, that this marl may be found on almost every farm in the southern range of towns in this county.

The indurated marl of the marl and sandstone formation is also a good manure, apparently a stimulant to vegetation. The iron in the rock is probably the substance which acts as the stimulant, though there may be other ingredients which produce the same effect. I have not seen it used extensively upon any crop, but where thrown upon the surface from excavations, the natural vegetation is always much more thrifty.

Bog ore is another material which may be applied as a manure in many places. I do not know that it has yet been used, except where a bed of it has been so near the surface, that the plough has scattered it. In these cases it is found that the crop is much more thrifty in that part of the field. This ore is so extensively distributed, that it could be obtained for manure on almost any farm north of the mountain ridge. It is also found in many places in the southern range of towns.

*Gypsum.—Plaster.**

The gypseous rocks extend across the southern part of this county, occupying all that portion south of Black creek, and between it and Allen's creek. In one or two localities gypsum has been found south of Allen's creek, but the formation is soon succeeded by the carboniferous limestone. Plaster has been obtained in small quantities at Cartersville, in the town of Pittsford, but the quantity was not sufficient for profitable working. At this place, the marl is decomposed to the depth of fifteen feet, and presents the appearance of a greenish gray clay. Marl of this character appears in several places along the canal, near this place and at Fairport, but the quantity of plaster contained in it is too small for working.

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* For a description of the gypseous marls and slate, see Sec. VI.

The workable beds of gypsum are almost wholly confined to the southern part of the formation. Along the valley of Allen's creek and Mill creek, two miles north, most of the plaster of Monroe county is obtained. Both these places are in the town of Wheatland. In the towns of Riga and Chili gypsum is found in thin seams, and small nodules disseminated throughout the rock. In these places, marls, which readily crumble on exposure to the air, can be substituted for gypsum. Until within a few years, the value of plaster as a manure, or stimulant for vegetation, has not been generally appreciated, but it is now much used; the demand is constantly increasing, and will doubtless continue to do so. It is mostly employed on grass lands, particularly on clover as preparatory to a crop of wheat. It is also used on wheat crops in the fall and spring; and Indian corn is much benefitted by the use of plaster. One bushel to the acre is generally considered a sufficient quantity for grass crops.

The manner in which plaster affects vegetation appears generally not to be understood; but it is doubtless by attracting moisture, and with it carbonic acid, from the atmosphere, and thus furnishing nourishment to the plant. Experiments prove that the perceptible effect, at least, of plaster, is the absorption of moisture from the atmosphere. In the use of this, as well as many other manures, the fact is overlooked, that plants are supported in a great degree by carbonic acid, and that much of this food is taken up by that part of the plant above ground. In this view of the case, any substance, above or beneath the surface, which presents carbonic acid to the plant, affords it food. Thus many substances which do not enter into the composition of plants, afford much food for them, either by absorbing it from other bodies and giving it to the plant, or affording it from their own decomposition.

At present, about 5,000 tons of plaster per annum are obtained from the town of Wheatland; of this quantity, 4,000 tons are used in Monroe county. This, however, is not the whole amount used in the county, as much plaster is brought from counties further east. Of the 5,000 tons, 1,500 tons are obtained from Mr. Garbutt's farm, in the north part of Wheatland; 1,000 tons from Messrs. Sage and Harman's, the adjoining farm; and 1,000 tons from the Messrs. McVean's farm, on lot 49. The remaining 1,500 tons are supplied from an extensive deposit at Garbutt's mills, on Allen's creek. Ground plaster is sold for three dollars per ton.

My acknowledgments are due to the Messrs. Garbutt, and to the Messrs. McVean, for valuable information, and for interest manifested in the progress of the survey.

Metals.

Iron is the only ore of any importance in this county, blende and galena, (or the sulphurets of lead and zinc) are found in the bituminous limestone, but never in large quantities. The argillaceous iron ore already noticed, extends from the Genesee river to the eastern limits of the county, but has not yet been examined in any part of this distance. In Wayne county, a few miles east of Monroe, it is three feet thick, and it would probably be found about the same thickness in Penfield.

Bog ore is found in many places, but no where in sufficient quantities for making iron. The deposites of this ore in Monroe county never attain a thickness of more than a few inches, and are of limited extent. In some places this ore is mixed with clay, producing yellow ochre.

Quick-lime and Hydraulic Cement.

Quick-lime is manufactured in considerable quantities from the bituminous limestone. There are several kilns near Rochester, and others farther west and south. East of Rochester lime is made from boulders and fragments of limestone on the surface and embedded in the soil. This limestone contains magnesian earth, and some other impurities, rendering the lime less valuable than otherwise it would be. In some localities certain strata only are used for making lime, and in other places the whole of the rock is too impure for that purpose. This is owing to the predominance of siliceous and aluminous matter.

Hydraulic Cement.

As this material is extensively used along the line of the Erie canal, it may be proper to offer some remarks on the quality and situation of the substance used for this purpose. Nearly all the hydraulic cement now used is brought from Onondaga.

I have already remarked, that there is no formation to which the term hydraulic limestone is exclusively applicable. The upper part of the calcareous shale as it graduates into the bituminous limestone becomes, by admixture of siliceous matter, a substance considered fit for hydraulic cement. The upper portions of the gypseous rocks, by similar admixture, becomes a silico-aluminous limestone, used for the same purpose.

From the circumstance that these rocks are an intermediate formation, or produced at the change of a shale into a siliceous limestone, no two strata of it are alike. For example, an upper stratum may be nearly a pure limestone, while a lower one is almost wholly argillaceous; thus no reliance can be placed upon its quality. The same stratum at different places may also change the proportion of its component parts. The greatest objection in regard to the stone used for this cement is, that it contains too much argillaceous matter, and for this reason will never withstand the action of freezing water. Much of the cement now made is of very inferior quality, and losses are constantly sustained from its use. This subject is one which requires strict and constant investigation, and the State of New-York would save large sums in the construction of her public works by procuring a cement of good quality.

A cement required to withstand the action of freezing water, should contain little argillaceous matter. Clay, in any form, absorbs water abundantly, and if frozen while containing water, the cohesion of the particles is destroyed. By this process, every time it is frozen, a portion of the surface at least is removed, and finally the whole mass. The chemical composition of this rock is so variable in different localities. and in different parts of the same locality, that this test cannot always be satisfactory. The chemical composition of a rock, producing good cement, should be ascertained, and similar external characters may afterwards be relied on.

A siliceous limestone, with a little iron or manganese in its composition, appears best adapted for hydraulic cement. Limestone of this character can be found at intervals in either of the formations mentioned; but experience is necessary to choose the proper portions, and some localities afford an article far superior to others.

The formations from which this limestone has been selected, extend across Monroe county from east to west: the one through the towns of Penfield, Brighton, Gates, Ogden and Sweden; the other through Mendon, Rush and Wheatland. At one locality in Ogden this limestone has been burned and used for cement in the locks on the Erie canal, and is said to have been of good quality. The same kind of stone may be found at the upper falls on the Genesee at Rochester. The best material of the kind which I have seen, is on the land of Mr. Miller in Penfield. The strata are from two to four inches thick, compact and siliceous. The location is near Rochester, and if it prove good and abundant, will be valuable.

We find a continuation of the rocks just mentioned, on Mr. Shumway's farm in Sweden, two miles south of the canal. At this locality the rock is of a light gray colour, fine grained and compact. The more siliceous portions would doubtless make good hydraulic cement, at least equal to that brought from more distant localities.

Some of the strata at the limestone quarries in Mendon would make hydraulic cement, but the character of the different strata is so variable that its quality could not be relied on unless constantly examined as it is used. The same rock is found in Wheatland, in the vicinity of Allen's creek, but at this place it does not make hydraulic cement.

The rock used in this county for cement, is usually blue or greenish blue when first exposed to the atmosphere, but becomes rusty gray and partially decomposed by atmospheric agents. In the locality last mentioned, the original colour of the stone is gray, or of the colour of pipe clay.

Hydraulic cement can be obtained within five miles of the canal throughout the whole extent of the fourth district. The same rocks which furnish the article at Onondaga, continue to the Niagara river, and a few experiments will prove that fifty or one hundred localities can be found to afford good cement.

Fire Stone.

A stratum of light gray siliceous limestone, of a porous texture, extends through the towns of Ogden and Sweden. This stone resists the action of ordinary fires for many years with little apparent loss or change. Its character depends on the presence of siliceous and magnesian earths, and the porous structure of the stone, which prevents it from cracking when heated. The stone can be obtained of any desirable dimensions at the quarry of the Messrs. Fenton, two miles south of Brockport. It is much used in this neighborhood for the backs and jambs of fire places, and also for door and window caps and sills. At the place where the stone is quarried the stratum is not seen in place, but masses of the broken outcropping edge are used.

Some of the strata of the gypseous rocks are sufficiently siliceous to be a good fire stone, and have been used for hearths of iron furnaces.

Some of the more siliceous strata of sandstone furnish a good fire stone, where great heat is not required.

Materials for Construction.

Common building stone is obtained in many places along the course of the bituminous limestone formation. A very durable stone is quarried from the bed of the Genesee river at Rochester, and is being used for the foundation of the new aqueduct. Some of the stone is injured by the presence of thin seams of shale, admitting water which on freezing will expand and split the stone. The portions free from seams of this kind furnish one of the best and most durable materials in the county. A very good stone for ordinary purposes of construction is obtained at the rapids near Rochester, but owing to its geodal structure it cannot be used where a smooth and even surface is required. Dark bituminous limestone is quarried in several places in Penfield. Among the quarries may be mentioned those of Mr. Heath, Mr. Baker, and Mr. Brezee. This stone is durable for building, and some other purposes, but from its brittleness is unfit for construction where liable to concussion. The stones are usually obtained in blocks from four inches to two feet thick, and of any required dimensions.

A siliceous limestone is quarried on the farm of Mr. Whittier in Ogden, and has been used as a building stone at Spencer's basin and other places. Limestone is obtained on the land of Mr. Abbott and Mr. Hill, in the south part of Ogden; the layers are from two to four inches thick, dark coloured and bituminous. Gray porous limestone is quarried on Mr. Bissell's farm in the north part of Ogden.

In West Mendon the upper strata of the gypseous rocks are extensively quarried for step stones, door and window caps and sills, lintels, blocks for corners, pedestals, &c. The rock is a silico-aluminous limestone, sufficiently hard and compact for ordinary purposes. When first quarried it is soft and easily worked, but becomes harder on drying. This stone is much used in Rochester and the adjoining towns, and the demand is constantly increasing. The common thickness of the layers is from four to eight inches, and they can be procured of any required dimensions. Except the more siliceous portions, these stone should not be used where they will be subjected to the action of freezing water, farther than to rains, which seem scarcely to affect them. The principal quarries are those of Mr. Wadham, at the village of West Mendon, and of the Messrs. Tinker, in the western part of the town. At the latter place we have a fine view of the alternations of siliceous and argillaceous strata and the connection of this rock with carboniferous limestone above. Limestone for ordinary building purposes may be obtained in the towns of Penfield, Brighton, Ogden and Sweden.

The red sandstone and the indurated marl of the same formation have been used for building stone, but experience has proved what a knowledge of their composition would have foretold, viz. that in Monroe county they are almost entirely unfit for any useful purpose whatever. Many apparently compact blocks of this rock will, in the course of a few weeks, if exposed, crumble into a loose mass. Where used in buildings, it has in some cases been little affected by the weather, but in most it has been rapidly destroyed. The aqueduct at Rochester, constructed of this stone, has been for years in a dilapidated state, and will soon be entirely unfit for use. The great objection to the stone, is the presence of a large proportion of aluminous matter, absorbing water and destroying the stone by the same process that the hydraulic cement is removed from the walls of locks. The stone used for the aqueduct now being constructed, is far superior to the sandstone, but still unfit for the purpose. The compact portions are durable, but there are seams of argillaceous matter, some of them scarcely perceptible, and others where this matter has been removed; all of these will absorb water, which, by expansion in freezing, will finally split the stone. The effect of freezing water on this stone, is illustrated in many of the locks in the vicinity of Syracuse, where every stone in which the seam occurs is split. This objection is a very serious one, and when a work of the magnitude of the Rochester aqueduct is to be constructed, more care should be observed in selecting the material.

The limestone of Monroe county affords no marble or materials for decoration. The more siliceous portions of the bituminous limestone furnish a fine material for McAdamizing roads, and are much used near Rochester for that purpose. Paving stones are obtained from the diluvial hills. Flagging stone is not abundant, but is found among the siliceous strata of the gypseous rocks.

The sandstone has been quarried near the outlet of Irondequoit creek, and used in the construction of piers at the mouth of the Genesee river. By the action of the waves and freezing water, it is very rapidly destroyed, and it becomes necessary to rebuild the piers almost annually. The stone from this quarry has recently been rejected for the construction of piers, and limestone substituted. An expense of several thousand dollars had been incurred in opening the quarry, and making the preparations, before the stone was rejected. Had the proprietors submitted the stone to the examination of some competent person, or to the common tests, all this expense would have been saved.

Fossil Bones.

During the past summer, some bones of the mastadon, or elephant, have been found near Rochester, in excavating the Genesee Valley canal. The bones obtained were a part of one tusk, portions of three ribs, and a part of two vertebra, besides some fragments of other bones. Through the kindness of Messrs. Langworthy and Brooks of Rochester, and Mr. Dexter, engineer on the canal, I am enabled to place these bones in the State collection.

I cannot leave this county without acknowledging my obligations to the gentlemen just named, and also to Prof. Dewey, Mr. Mills, civil engineer, to Mr. O'Reilly and Mr. Tucker, of Rochester. Many other gentlemen, in different parts of the county, have manifested a lively interest in the progress of the survey.

LOCAL AND ECONOMICAL GEOLOGY.

Orleans County.

Surface of the Country.

The most prominent character of Orleans, when compared with the adjoining counties, is a remarkable evenness of surface. Indeed, the whole county may be considered as nearly a level, and in traversing it at any part in an east or west direction, there is neither ascent nor descent of any consequence, nor any irregularity of the surface, except where the streams have worn down their present channels. This is especially the character of all that part of the county north of the Erie canal, from which to Lake Ontario there is a gradual and almost imperceptible descent; the country presenting an uniform level face, with the exception of the ridge, on the summit of which passes the ridge road. The Erie canal is in this county at an elevation of 271 feet above the level of Lake Ontario, and its distance from the lake is between eight and ten miles.

The level surface continues south of the canal for about two miles, when we meet a sudden rise in the country; upon ascending which we arrive upon the limestone range. This rise bears the name of Maple ridge at Shelby, two miles south of Medina, and following the course of the canal, it is seen at Millsville; then going east it passes about two miles south of Albion, which distance it preserves for two and a half miles, when it gradually inclines northward and crosses the transit line at a road one and a quarter miles from the canal. Hence it continues east, and soon reaches Jefferson lake, of which it forms the southern shore. From this small lake it turns rapidly to the south, and reaches

Clarendon centre, continues still south for about two miles, and then turning to the east again, passes into the county of Monroe. This ridge. or terrace, has a pretty uniform elevation of about 50 feet.

From Maple ridge southwardly, the country has a very gentle rise for about two miles, when we arrive at another distinct, but more moderate step, which is about 30 feet in height, South of Shelby this rise bears the name of Windfall ridge, and in other parts of the county is known as Limestone ridge. Its course is east and west, parallel with Maple ridge, with which it preserves a distance of about two miles, and can be followed from the western part of the town of Shelby, passing by Barre Centre eastward to the transit line. After ascending this terrace we are on the summit of the limestone range, and on the highest ground in the county. The country now continues quite level for about two miles to the south, and then descends gradually to the Tonnewanta marshes, which in this county are only 90 feet above the level of the Erie canal.

With the exception of these two steps, or ridges, as they are called, which traverse the county from east to west, the whole of Orleans presents a nearly level and uniform surface, unbroken by hills or valleys, and in some places north of the ridge road the descent to the lake appears hardly sufficient for effectual drainage.

The only irregularities we noticed are as follows: A little east of Albion, and almost in sight of the Erie canal, the surface is broken, and composed of sand hills for about a mile or so; this is the most uneven spot we met with in the county of Orleans. A short ridge occurs about half a mile north of Barre Centre, running east and west; it is about two miles in length, and terminates at each end in a swamp.

Lake Ridge.

This ridge, upon which passes the ridge road, requires a more particular description. It passes through the county of Orleans at a distance of from six to eight miles south of Lake Ontario, preserving an uniform elevation above the lake, and continuing unbroken and uninterrupted except where cut through by the streams on their way to the lake. It is composed of sand, gravel and pebbles. The elevation above Lake Ontario, as near as could be determined in Orleans county without actual measurement, is over two hundred feet.

Where the ridge enters the town of Ridgeway from the county of Niagara it is eight miles distant from the lake. Its course for about three miles is northeast; then east for three miles, passing through Ridgeway corners to the village of Oak Orchard, where it is only six and a half miles from Lake Ontario; thence, with a slight curve, its course is a little north of east to Gaines Corners, where it is six miles from the lake; from Gaines its course is firstly northeast for about two miles, when it bends gently to the southeast, and passing through Sandy-creekville it enters the county of Monroe at a distance of nearly eight miles from the lake.

At Ridgeway the ridge is very distinct, and about one hundred yards wide at the base, by measurement. A mile east, the ridge is a little uneven, and there is a rise and fall in the road, which consists of fine sand; and two hills, like those raised by the waves and winds on the present shore, extend south beyond the regular ridge. Between this place and Oak Orchard it is quite distinct and high, and the northern slope is regular, but the southern is mostly wanting, as the top of the ridge, which here is twelve feet high, extends on a level for from two hundred to three hundred yards to the bank of Oak Orchard creek. This creek runs from Ridgeway to Oak Orchard, three miles, parallel to and a little south of the ridge, and in one place approaches to within twenty feet of the ridge road: altogether the road is nearer the creek between these two places than marked on Burr's map.

In the western edge of the village of Oak Orchard the ridge turns to the south and crosses the creek obliquely between two mills to the south side of a small creek which comes in from the east, which creek it follows up for a short distance, then crosses it by again turning to the north, and gradually approaches and reunites with the ridge road more than a mile east of the village. The character of this disturbance or interruption of the ridge, where Oak Orchard creek cuts through it, is precisely such as we notice in the present beach of the lake at the mouths of creeks. The ridge bends in towards the south, forming as it were a litle bay, and comes again into line about two miles east. The creek here widens and has quite a bottom, and altogether the appearances suggest the idea that this spot was the former mouth of Oak Orchard creek, and that there was a small bay running into the land.

Where Otter creek crosses the ridge, it presents a similar disturbance, and at Sandy-creekville, the ridge also bends a little to the south, but soon returns into line. All the instances of disturbances are to the south of the regular line of the ridge.

As before mentioned, the country north of the ridge declines towards the lake, with an uniform and gentle slope, and we noticed that this northern slope is regular and undisturbed in places where the summit of the ridge is broken and uneven. Generally, too, we see the southern slope of the ridge quite distinct, although it is not so regular as the other.

The ridge road passes through Orleans county on the summit of the lake ridge, which is level on the top, and of just the proper width and shape for drainage. At Oak Orchard the road leaves the ridge for about two miles, and also at Otter creek and Sandy creek for a shorter distance, where the ridge forms a bend to the south.

Lake Shore.

The shore of Lake Ontario forms nearly an uniform straight line from east to west, and presents a bank of moderate height, in general protected by a beach. The bank in Yates, immediately north of the Centre, is about ten feet in height, and consists of sand and clay, resting on red sandstone, which is here exposed for some distance. There is also a narrow beach.

At the mouth of Oak Orchard creek, the bank is eight to ten feet high, and composed of earth, clay, and sand. No rock is visible, although one mile west, layers of sandstone are exposed on the shore, and have been wrought for the works at Torry's harbor. Operations are now in progress for the formation of this harbor at the mouth of Oak Orchard creek, by authority of the general government. Two piers are to be constructed, which will be 1,200 feet in length, and when the bar is removed, the creek will be navigable to Stillwater, a distance of five miles.

During the summers of 1836 and 1837, the lake encroached on the land. On the east side of the creek, three or four rods were removed, together with a fine beach of two or three rods in width, so that at present the waves dash against and undermine the bank, which is constantly falling into the lake. In the course of the last summer, (1837,) the bank, for a limited extent, and to the width of 30 feet, has been swept away by the waters of the lake.

At Torry's harbor, we noticed several small mounds, considered to be of Indian origin, and similar ones are said to be numerous in the town of Shelby, a short distance south of the canal.

In 1836, Lake Ontario was very high, and in 1837 was a little higher, but has since fallen six inches.

North of Kendall Centre, in some places the country declines gradually to the lake, and there is only a high beach, and no bank.

The pebbles which compose the beach on the shore of Lake Ontario are flat, smooth, and rounded, and consist of limestone with fossils, red sandstone, and quartz, granite, and other primitive rocks, which are unlike the rocks in this county, or elsewhere in the State. For the sake of comparison, the lake, and also the ridge pebbles, were collected from various and distant points.

Creeks.

Oak Orchard creek is the principal water course in Orleans county. On the east side of the creek, at the mouth, we saw two or three mounds about three feet high, and ten feet in diameter, containing human bones.

It will be noticed, upon reference to the Map of this county, that all the creeks have a general bearing to the east. This may be owing to the direction of the rock fissures, which are generally northeast.

Swamps.

The Tonawanda marshes extend along the southern edge of Orleans county, and occupy a part of Clarendon, Barre, and Shelby. The country descends from the Windfall or Limestone ridge to the marshes, which are about 90 feet above the level of the Erie canal.

As the Tonawanda marshes are mostly in Genesee county, a full description of their character is deferred to a future report.

Immediately south of the ridge, in the north part of Murray, is a tamarac swamp, about three miles in length, which communicates at one end with Marsh creek, and the other with Sandy creek. Its reclamation has been commenced by drainage.

Soils.

The prevailing character of the soil north of the ridge is sandy. Limited tracts of a clayey nature occur, and were observed more especially near the lake.

Proceeding from Ridgeway to the lake, we find a sandy soil extending from the ridge to within two miles of the lake, then clay predominates, and the soil consists of a clay loam. Here is a strong and warm soil, which produces good crops. But little plaster is employed as manure.

From Sandy-creekville the country inclines very gradually to the lake; about three miles north of the village we cross a tract of clay land about one mile in width. Two miles west of the village it approaches quite to the ridge.

In Carlton, the soil is a sandy loam.

The northern part of Orleans embraces many fine farms, and although the soil is sandy, are very productive. Farms immediately along the ridge are also more productive than we should expect from the character of the soil, but the sand of the ridge we suppose to be not exclusively siliceous, but to contain considerable lime.

In the immediate vicinity of Albion clay prevails in the soil, and about two miles east there is a very sandy tract, of limited extent.

The soil upon the limestone range in the towns of Shelby, Barre and Clarendon, appears to be an excellent mixture of clay, sand and lime, and is very productive. But little plaster is used in this part of the county, and there is evidently but slight necessity for it, inasmuch as the soil is the result chiefly of the underlying limestones, and limestone shales. The road from South Barre to Clarendon runs upon the limestone range.

Springs and Mineral Waters.

North of the Erie canal the springs and wells furnish good soft water. On the limestone range, and in the county south of the canal, the water is hard, containing lime.

At Barre, in digging a well, rock occurred at 24 feet; upon passing into the rock 17 feet a cavity was found, from which a copious supply of water issued, rose to the surface, and is permanent.

At South Barre, limestone is found at the depth of 17 feet, and water generally obtained at the surface of the rock, or upon penetrating it for a short distance.

Salt Springs.

A number of salt springs have been noticed in Orleans county, and always upon the range of sandstone.

In the town of Ridgeway, one and a half miles north of Medina, near Oak Orchard creek, is a saline spring, now neglected and nearly filled up, where salt was manufactured in the early settlement of the county, more than twenty years ago. One or two weak brine springs were also mentioned to us as occurring on lots 39 and 40 in Ridgeway.

A small salt spring is also known in the town of Gaines, at Fairhaven.

In the town of Kendall, lot 137, now occupied by Mr. Hamblin, there is a brine spring, at which salt was formerly made.

Near Scofield's mills, Johnson's creek, in the town of Yates, salt was formerly manufactured, from a spring now neglected and filled up.

A salt spring was discovered in the east bank of the Oak Orchard creek, at the village of Oak Orchard, where salt was manufactured by Mr. Bennett. He bored to the depth of 140 feet, and obtained a stronger brine, but the quantity was not increased. The rock is red sandstone, of a soft, slaty nature. The works have been discontinued, and gone to decay, and no taste of salt can at the present be perceived.

At Holley, three salt springs were known, and used for the manufacture of salt. They are all situated in close proximity, in the bed of Sandy creek, immediately at the south side of the culvert. One spring or well is now seen on the west side, and on a level with the bed of the creek; having been neglected for some years, and having been exposed to overflow from the creek, its proportion of saline matter could not be determined, but it has a decided saline taste. Another small spring is immediately opposite, on the east side of the creek; and here, about four years since, borings were made to the depth of about thirty feet, but no subsequent operations were performed. A third spring was discovered immediately under the culvert, and a wooden log was laid to conduct away the water. At present all these springs are neglected. About the year 1821, considerable salt was made at these springs, and was sold at five dollars per barrel; but when the Erie canal was constructed as far as Holley, the article was brought from Salina, and furnished at a rate so low that the works at this place and others along the canal were at once discontinued.

Sulphur Springs.

There are two sulphurous springs at Holley village, one of which is situated on the premises of Mr. Frisbie, postmaster. It is quite weak. The water of these springs has been used as a bath with advantage in cutaneous affections.

Clay.

Blue, yellow, and variegated clays, occur at many points in Orleans county, and are employed in the manufacture of brick of a fair quality, as at Albion, where there are several kilns immediately in the village. A handsome blue clay was seen at Linden, a thriving village one mile south of Yates centre. Blue and yellow clays appear at several points along the lake shore, forming limited beds in the banks, but at present they are not explored.

Boulders.

A variety of primitive boulders were noticed along the Erie canal between Hulberton and Holley; also a little north of Medina, between the canal and ridge, and on the lake shore, in Yates. In the northeast part of Barre, on the limestone range, one large boulder of granite was observed, with grayish quartz and opalescent feldspar. Also at the same place, one very large transported mass of sandstone.

These erratic blocks are found scattered over the surface, but I think in less profusion than farther east. Near Jefferson lake are several large masses of granite, with dark blue feldspar, resembling the rock which occurs in place in Essex county, where it forms whole mountains. These boulders are unlike any of the rocks of the western counties, and have travelled from the north. At Oak Orchard, on the east bank of the creek, one small boulder was noticed, consisting of dark limestone with fossils distinguished as belonging to the limestones which repose upon the sandstone, as seen in the southern part of the county; but from its situation it was considered to have been brought down the stream by the high waters of the creek.

Marl.

A limited deposit of calcareous marl was noticed about one mile south of Holley, on the west side of Sandy creek. It is white, in a state of powder, and contains an abundance of shells, principally the Helix albolabris (white tipped snail.) It occurs on the side of a hill, resting on the red sandstone, and was exposed in digging a raceway.

Calcareous marl also occurs in a swamp on the farm of David Hooker, two and a half miles north of Medina.

Calcareous tufa forms in large quantities at the falls of Oak Orchard creek at Shelby, from the decomposition of the calcareous shales.

Bog Iron.

Several deposits of bog iron were noticed in the county, which, however, are not explored, so that their extent is unknown. It occurs in solid masses one mile west of Albion, on the farm of Stephen B. Thurston.

One mile east of Ridgeway corners, on the farm of David Hooker, on the south base of the ridge, bog iron occurs in grains, both loose and forming small masses in the soil, which is here a sandy loam. It has the local name of shot ore. Bog iron also occurs one mile, and one and a half miles west of Ridgeway corners.

In Ridgeway, between the ridge and west branch of Oak Orchard creek, is a swamp covering 400 or 500 acres. This contains an abundance of bog ore, which has been manufactured into iron by Mr. Bennett.

Quick-lime.

The limestone range in the southern part of this county furnishes an abundant supply of materials for lime of an excellent quality. Kilns are erected south of Shelby, at Millsville, about one mile south of Williams' quarry in the town of Barre, and at other places in the limestone region. At Barre, and on the range to Clarenden, the rockis of a light blue colour, and occurs in large irregular and ragged masses, either forming ledges, or scattered profusely over the surface. It resembles very closely in character the limestone which occurs at the Bullshead, one mile from Rochester, and contains generally the same fossils.

Two miles west of Farwell's mills, a dark blue limestone occurs, bituminous, and containing fossils. It is a magnesian limestone.

Hydraulic Lime.

We were informed that the upper layers of the rock at the falls of Oak Orchard creek, at Shelby, are advantageously used for the manufacture of water cement. They consist of a sandy limestone, but do not resemble in texture and other characters the best hydraulic limestone.

At Farwell's mills, Clarenden, there is a deposit of sandy limestone, slightly bituminous, agreeing in texture, colour, and other characters with the most approved hydraulic limestones of the western counties. It occupies the brow of the hill which rises immediately behind the village, and according to Judge Farwell, has been burned, and converted into water cement of an approved quality.

Building and Flagging Stones.

Red sandstone prevails in the northern half of the county, and is exposed almost constantly along the Erie canal, from Holley to Medina. North of the canal it is seen in the banks or beds of the creeks, and in other situations near the surface, which it immediately underlies. It has been mentioned in the preceding pages, as frequently soft and argillaceous, and not durable: yet there are courses of this rock which are more dense, or siliceous, and furnish an excellent material for building.

A little north and west of Medina is a quarry, which was worked during the past summer, and furnished a handsome pink coloured sandstone in large slabs and blocks, with smooth surfaces and of good texture.

The freestone was quarried on Otter creek, about two miles south of Eagle harbor, for some of the works on the Erie canal. At this quarry the layers are thick, hard, not slaty, nor argillaceous as elsewhere, and yet it crumbles upon exposure.

In the south-east part of the village of Albion, a quarry was in operation, which furnished rock of a reddish or variegated description, intended for buildings. The same quarry also furnished courses of a gray sandstone of a firmer texture, with less argillaceous matter, and altogether more durable.

The upper layers of the sandstone near Albion consists of a grayish sandy rock, which is preferred for the corner stones of buildings. The upper layers at Medina and Holley are very siliceous, and too hard to be wrought with advantage. For foundations and rough work they are well adapted, and are of a texture to withstand the effects of moisture, frost, and all other exposure.

The sandstone or freestone was also employed in the construction of the culvert over Sandy creek at Holley, but the arch below showing a tendency to disintegration, a new arch, composed of limestone, was subsequently built within, in order to sustain the first. Hood's quarry is on lot 31, in Clarenden, about one mile south-east of Holley. We have already mentioned that it was quarried near the mouth of Oak Orchard creek, and used in the works pertaining to the harbor.

The rock under consideration is mostly inclined to disintegration upon exposure to the weather, although quite firm when first quarried. In this respect it resembles the sandstone of the Genesee river, below Rochester, of which it is a continuation. The surface of the layers at some points, as at Medina, are covered with fossil stems of vegetables, chiefly of the family of fucoides. The most common species is the fucoides Harlani, (Conrad,) in the form of stems which branch and cross each other, and which possess transverse striæ, and other evidences of an organic nature. Another very pretty fucoides occurs at the same locality, apparently consisting of short thick leaves, resembling a cactus, and with no apparent stems. The above are accompanied by other species of an irregular form. The new genus instituted by Mr. Conrad, *Dictuolites*-Beckii occurs in the uppermost layers, and has not yet been seen at any depth in the sandstone. It occurs in the upper layers one mile south of Holley. About 40 feet deep in the sandstone occur one or two layers of about two feet in thickness, containing a new species of Lingula, the L. cuneata, associated with fresh water shells, viz: Unio primigenius, Cyclostoma pervetusta and Planorbis trilobatus, as described by Mr. Conrad. Associated with the above shells, is a species of Cytherina, very much resembling that which occurs in the bituminous limestone of Wayne county.

At Medina can be seen, in great perfection, those appearances which have been called *ripple marks*. They consist of parallel furrows, or depressions on the surface of the layers, resembling exactly the tide or ripple marks in the fine sand on the shores of rivers. They are slightly waved, or serpentine, and sometimes run into each other. Near the culvert at Medina, these furrows appear on both sides of the canal, without any interruption, for about 100 yards. They exist on the upper surface of the upper layer of the sandstone, which is here gray and very siliceous, and contains the Dictuolites, or net-like fucoides, which sometimes continue across the furrows, as if they had been inflexible. These furrows are on several of the top layers, and occasionally we observed the marks, not on the upper surface, but having a small portion of rock above them. The above remarks refer to the rock on the south side of the canal. Direction of the furrows east 20° north. At one limited spot the direction was N. W.

The furrows, or marks, on the north side of the canal, immediately opposite to the preceding, have a general direction of west 20° north, and in one or two limited spots they were east and west.

The floor of a mill, or factory, immediate at the falls of Oak Orchard creek, Medina, consists of a thick gray layer of sandstone, about 40 feet deep in the rock. This layer presents an extensive surface covered with large and remarkably distinct furrows. Direction east 20° north.

On the shore of Lake Ontario, north of Yates' centre, and ten miles from Medina, the sandstone is red and variegated, and contains similar marks, or furrows, whose direction is north and south, and also north 20° east. These layers are at a depth of more than 500 feet in the sandstone.

Similar appearances are presented at Holley, on a layer of sandstone, which also contained an individual of the fucoides Harlani, which had evidently bent and followed the irregularities. Direction of the furrows not ascertained.

I have examined similar furrowed surfaces, or water-worn surfaces, of the Graywacke at Saugerties, on the Hudson river; they are common in the shales and sandstones of the Catskill mountain; and I have also observed them on layers of a dark, compact limestone, which is quarried at Glasco, three miles west of Saugerties.

Similar appearances have been noticed in Great Britain. In 1831, Mr. G. P. Scrope, after visiting the quarries of Dumfries, found ripple markings, and abundant foot tracts of small animals, on the Forest-marble beds north of Bath.—Phil. Mag. 1831, p. 376.

We have not seen any bird-tracks, or other impressions of animals, in the Fourth Geological District.

Limestone.

Thin layers of limestone are extracted from the bed of Oak Orchard creek, between Medina and Shelby, and used at the former place for flagging. They appear to be of a siliceous character, occur in large slabs, and the surfaces are frequently covered with fossil vegetables of the family of fucoides; they strongly resemble the petrified stems of vegetables.

Williams' quarry, in the the northeast part of the town of Barre, furnishes a siliceous, or sandy limestone, at present used for fences and underpinning, and which resemble the rock employed in Monroe county for the preparation of water cement.

A gray, porous, siliceous limestone is quarried at Farwell's mills, Clarendon centre, and used in buildings. Some of the layers contain a considerable proportion of lime, although they mostly consist of a porous, flinty rock, much resembling the French Buhrstone. The quarry is quite extensive, and occupies the summit of the ridge which overlooks the village. The layers are large, and from one to three feet, or more, in thickness, and are generally wrought into proper shape and size with facility. This rock seems better adapted for building and other purposes, where durability is required, than any we have seen in Orleans county. It was employed for the upper facing, or coping, of the culvert at Medina, and appears to be unaffected, thus far, by exposure.

Our acknowledgments are due to Judge Dixon and Judge Turner, of Medina; and to Rev. Mr. Beadle and Dr. Morgan, of Albion, for personal attentions and assistance furnished us in the survey of Orleans county.

LOCAL AND ECONOMICAL GEOLOGY.

NIAGARA COUNTY.

Surface of the Country—Streams, &c.

The mountain ridge* is the most remarkable feature in the surface of this county. This ridge gradually rises to the westward, and at the Niagara river is about 350 feet above the level of Lake Ontario, and 250 above the country on the north. At Lewiston, the whole descent to the north is made at one offset, but farther east it descends by two, making two grand steps, or terraces. This double offset is produced by the unequal hardness of the rocks; a stratum of sandstone causing the lower one, while most of the rocks below and above it to the limestone are soft. In the eastern part of the county, this stratum of sandstone has so far declined that it dips beneath the general level of the country north. In this part of the county, the ascent from the north to the top of the ridge is from 80 to 100 feet. The mountain ridge passes through the towns of Lewiston, Cambria, Lockport, and Royalton. From the foot of this terrace the country declines gradually towards the lake, and the top of the terrace is the highest land in the county. From thence there is also a gradual slope south, to the Tonnewanda creek. A few of the streams flowing northward, rise south of the terrace; but these find their way to the north through gorges worn in the rocks by an immense body of water, covering the whole surface and flowing in that direction. With these exceptions, it will be perceived from the map, that streams rising south of the terrace flow into the Tonnewanda or the Niagara. The streams flowing to the lake have cut their channels deeply into the red marl and sandstone, and their great breadth and depth indicate a much greater quantity of water at some previous time.

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* "Mountain ridge" and terrace have been used indiscriminately; the former is the name commonly applied, though the latter is more appropriate.

No diluvial hills rise more than a few feet above the general surface. The soil every where is composed in part of water-worn materials; but the hills, if there ever were any, have been levelled by some subsequent cause.

In descending the terrace on the north, we find hills of diluvial matter, extending from the top and sloping gradually off to the surface below. Where the northern extremeties of the hills have been excavated, we find large rounded masses of limestone and shale, from the rocks south, with masses of granite. These are all mixed together in confusion; and the masses of limestone are worn and scratched, as having been tumbled along with blocks of harder rock.* From these appearances, and the form of the hills, it is very evident that a current of water flowed from the south. But again, on the summit of this terrace we find masses of sandstone from the north, often wedged into fissures of the limestone, as if driven there by violent force. Although traces of opposing currents are not so apparent on the surface, their effects are more evident on the rock beneath. In every case where I examined the limestone in this county, it was worn and scratched from diluvial action. This appears to have been effected by a force from the south, but in some places there is undeniable evidence that a powerful force was exerted from a northern direction. The following facts corroborate this opinion. We often find fissures in the limestone having an east and west direction; the rock forming the southern edge of this fissure is broken up in a manner that proves a force applied on the northern side, for a force in any other direction could not produce the same result.

Several extensive marshes along the lake shore are gradually being filled with materials brought into them by streams, and deposited while the outlets are dammed up by beaches. Swamps on the south side of the ridge road contain deposits of partially decomposed vegetable matter, to the depth of three or four feet. When the swamps are filled with water, this substance expands, and the surface is elevated considerably above the level which it occupies when dry. When drained, and the vegetation burned, the vegetable soil below takes fire and is with difficulty extinguished. A swamp of this character commences five miles east of Lewiston, extends three miles, and is about half a mile wide. The vegetable soil is from one to three feet thick, and underlaid by a clay soil, though in some parts a deposit of calcareous marl is interposed.

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* Through the kindness of Mr. Barrett, engineer, of Lockport, I was enabled to procure a drawing, representing the appearance of these hills in connection with the mountain ridge.—This will appear in a future report.

The vegetable soil of these swamps will eventually become peat, indeed its composition is now the same, but it is not yet sufficiently decomposed to allow the particles to cohere. The swamps south of the ridge road can readily be drained, and will become fertile meadows. The south part of Niagara county is not thickly inhabited: the ground is low and marshy; the growth tamarack, elm, ash, &c. The land only requires draining to become as good, or better, than any in the county. The junction of the limestone and gypseous rocks is near the southern line of the county, and at this junction we always find some of the best land. The dam across the Tonnewanda, near its mouth, is a serious impediment to draining this region. This stream was originally sluggish, and is made more so by this dam. Unless the streams flowing into the Tonnewanda are cleared from obstructions, and the accumulated water carried off, the south part of this county and the north of Erie must long remain uninhabited.

In following the lake ridge from the east to Eighteen-mile creek, it suddenly disappears, and is again seen four miles farther west. When the lake was at this elevation, probably a broad bay at the outlet of this creek, prevented the continuation of the ridge. About seven miles west of Eighteen-mile creek, the ridge divides, and a portion, precisely similar to the continuous ridge, after extending two miles in a northwest direction, suddenly terminates. This fork was evidently a bar projecting into the ancient lake.

Lake Shore.

The lake shore, forming the northern boundary of this county, rises abruply to the height of from ten to thirty feet. The bank is generally composed of gravel, sand, and clay, with a beach of pebbles at its base. The lake at its present elevation washes the foot of the bank, and in many places is undermining and wearing it away rapidly. On some farms ten feet in width have been worn away in the course of a year, though the average loss of land may be not more than four or five feet annually. Being upon the lake shore in this county during a violent storm of two days, (25th and 26th of Oct. 1837,) I found that, during that time, the soil to the width of three or four feet had been worn away. This effect was not confined to a single spot, but extended for miles. The waves, during storms, are dashed against the shore with such force, that they are thrown entirely over the bank. It has thus become a matter of much importance to the farmer, to protect his land against the ravages of the lake.

Sandstone appears in the bank in many places, and at such points the land is in a measure protected from the action of the waves. All the projecting points along the lake shore are of sandstone, or marl of the same formation, and where it does not appear in the bank, it is found at a little depth below the level of the lake. The most northerly point of this rock on the lake shore is at least six hundred feet below the upper stratum of the formation.

The pebbles along the lake shore are red sandstone, and greenish blue siliceous limestone, both containing fossils, the latter rock more abundantly. The fossils in these pebbles are *Corallines*, *Orthocera*, bivalve and univalve shells. Both the character of the stone, and the fossils, differ from any in the Fourth District. From the situation and appearance of these pebbles, they may have been derived from a lower member of the marl and sandstone formation. The mineralogical character of the pebbles along the lake shore farther east, is very similar, but they contain no fossils. The pebbles in the lake ridge, in Niagara county, exhibit the same fossils, and are precisely similar, to those on the lake shore.

The ponds and marshes at the outlets of streams along the lake shore are gradually filling up by the same process as in Monroe county. Those in Niagara county are but few.

Abraded materials from the banks are transported by the water, and form bars and shoals at the mouths of smaller streams. The only river is the Niagara, and the immense body of water brought down its channel entirely prevents any obstruction from depositions at its mouth.

Boulders.

Boulders of granite, and other rocks, are scattered over the northern part of the county, in some places the surface being literally covered with them, while in the southern part they are almost entirely absent. In this respect Niagara county differs from Monroe, where in the southern part boulders are very abundant and of large size. They are more abundant in the eastern part of this county than towards the Niagara river. These boulders appear to follow certain courses, and to extend in great profusion over certain districts; this distribution appears to have been governed by some law, and we may yet arrive at data which will enable us to describe the diluvial and its varying characters with as much, or more precision than we now do a stratum, or a series of strata in an older formation.

Soil.

The soil between the mountain and the lake ridges contains a large proportion of clay, although extremely fertile. The lake ridge and the soil, for a limited distance, on either side, is sandy or gravelly. North of the ridge road, the soil for a short distance is clayey, except along the streams, where it is sandy. North of this point, to the lake shore, the prevailing soil is sandy loam, of a yellowish colour, inclining to brown where the sandstone approaches the surface, as it does in many places. It contains carbonate of lime, which often cements the gravel below the surface. All kinds of crops flourish on this soil; and wheat in Niagara is considered better than in the counties adjoining.

The indurated marl, or marly sandstone, does not absorb water, and when it approaches the surface, unless on a declivity, the water is too long retained. The soil in these cases becomes wet and cold, and in rainy seasons the crops are sometimes injured.

In some places in the northern part of this county there are alternations of a clayey with a sandy soil, often several miles in extent. The sandy portions are a little elevated above the loam or clay soil, as if transported by a gentle current over the bottom of the ancient lake, which might move sand; while clay, if once deposited, would be less easily moved.

The soil north of the ridge road seems divided into nearly equal proportions, in one of which sand predominates, and in the other clay.

The soil upon the mountain ridge is sand, or sandy loam, for a mile or two south, when the proportion of clay increases. Along the Tonnewanda, clay soil predominates. This character of the soil is owing to the gypseous marls, which are argillaceous, in the lower part of the formation. These marls extend into Niagara county, their outcrop being a little distance north of the Tonnewanda creek.

Clays.

Beds of clay are found in every town in Niagara county, though many are of impure quality from admixture of sand and carbonate of lime. The demand for bricks has, however, been confined to one or two points, and in consequence these beds have not been explored. The prevalence of limestone, and limestone shale, more or less affects all the beds of clay, except those along the lake shore.

Many of the bricks manufactured in the county are of inferior quality, arising from the use of sandy loam mixed with the clay, instead of a pure siliceous sand. This loam contains abundance of fine particles of limestone, and when burned becomes lime; the action of water on such bricks is rapidly destructive. The bricks made near Lockport are of this character.

On the lake shore a bed of clay continues almost from the eastern to the western extremity of the county. In some places this bed thins out, and its place is supplied with gravel or loam, and sometimes the clay is intermixed with one or both these substances; the upper part is gray and less pure than the lower. The lower part usually is of a bluish colour, which sometimes extends throughout. This blue clay is frequently variegated with spots of brown and green. Where the lower part of the stratum is seen, it rests on a partially indurated deposit of gravel and clay, of a reddish colour, and this rests on the red marl or sandstone. The clay is from two to six feet thick, and often contains pebbles and boulders, similar to those on the lake shore. Frequently we observe alternations of the clay and a part of the gravel stratum below and above, and the clay is often much bent and contorted, although it rests on a nearly horizontal base. These alternations and contortions are in many places very remarkable, and would induce the belief that almost any position, observed in stratified rocks, may be given during their deposition. The presence of pebbles and boulders in the clay, proves that the water from which it was deposited had sufficient velocity to transport large and heavy materials.

The gray loamy clay above the blue clay sometimes attains the thickness of four or five feet, and in some places occupies the place of the blue clay, where this has apparently been removed. The gray, where it occurs, is entirely distinct from the blue, and appears as if it might have been deposited at a subsequent period. In this clay we find the calcareous concretions called clay stones, or "clay dogs;" these substances assume all imaginary forms, sometimes the most fantastic. They are often in the shape of spheres, and sometimes two or more of them attached together. They appear at regular intervals in the strata, and commonly a line of them marks the junction of the gray with the blue clay below. These substances are an earthy carbonate of lime, which is apparently deposited from the water percolating from the surface. Fibres (apparently vegetable) extend from the surface to the depth of three or four (sometimes twelve) feet, and around these fibres, as a nucleus, the deposit is made. The gray loamy clay is pervious to water, while the blue clay is not. The fibres never extend into the blue clay but always terminate at its surface. We find the clay stones surrounding the same fibre at different depths, and can often trace the connection of several. Sometimes there are merely rings of calcareous matter, the internal part still being clay. Those formed directly around the fibre are usually perforated, but others are often attached on every side, which are entirely solid. It appears as if the water was conducted downwards by this fibre, and the solid material deposited on every side, forming a ring. But when the accumulations are large, or when the stratum below is impervious, the calcareous matter is forced out on every side, and produces the fantastic forms which we so often find.

This deposit of clay is found on the Niagara river, and extending nearly a mile from its mouth. At this place, the gray clay above attains a much greater thickness than at any other place.

Sands.

No extensive deposits of siliceous sand occur in this county. In many places along the lake shore it appears in small quantities. Sand of sufficient purity for mortar is found in many places.

Water and Springs.

The county is well watered throughout, both by springs and streams. Along the foot of the mountain ridge, numerous springs of fresh water gush out from fissures in the limestone, or at the junction of the slate and limestone below. Water is readily obtained in almost any situation by penetrating a few feet below the surface. North of the mountain ridge, it is sometimes necessary to penetrate a few feet into the marl or sandstone, before a sufficient supply is obtained.

The streams in the north part of the county have generally worn a channel several feet into the rock, and the water which finds its way through the soil to the surface of the rock is drained off by these outlets. Many of the streams, to judge from the gorges and channels in the rocks, must have been much larger at some former period.

Springs of hydro-sulphuretted water "sulphur springs" are of frequent occurrence in many parts of the county, but few of them have any celebrity. Some contain sulphate of magnesia in solution, in sufficient quantities to affect the taste very sensibly. A spring of this character occurs in the bituminous limestone on the bank of the Niagara river, two miles below the falls. Preparations have been commenced at this place for the accommodation of visiters. Several similar springs occur in the shales along the Niagara, between the falls and Lewiston. Near Lewiston a copious spring rises from beneath the stratum of gray sandstone, about one hundred feet from the top of the formation. The water of this spring was slightly charged with sulphuretted hydrogen, and contained a notable proportion of sulphate of magnesia. Its situation, however, is almost inaccessible, and for that reason will not soon become a place of resort. Other similar springs, but less copious, occur in the vicinity. "Sulphur springs" are found in many places in the the shale and limestone along the northern slope of the mountain ridge. They occur wherever iron pyrites is disseminated through the rock. At Lockport, in the limestone above the shale, a spring of this kind, when opened, discharged gas sufficient to support a constant flame from a small tube. On the Tonnewanda creek, about two miles from the village, on the land of Mr. Vandenburgh, is a spring of this kind, which has some celebrity.

I observed but one chalybeate spring in the county. This is on the farm of Capt. Leonard, two miles north of Lewiston. There are several other springs at the same place, and the water of some is said to yield salt on evaporation. Two miles east of Lewiston a copious spring rises from the shale in the mountain ridge.

Salt Springs.

In Niagara county, as in Monroe, we find salt springs along the course and in the beds of almost all the streams in the northern part of the county. These springs are none of them copious, but we frequently find three or four in the distance of half a mile. Several of these springs occur along the course of Eighteen-mile creek, between Lockport and Lake Ontario. Salt springs, affording small quantities of water, occur along Golden Hill creek and Johnson's creek. Salt was formerly made from a spring within three miles of Lockport; at the time we examined it, it was filled with fresh water. The rainy season commenced before the northern part of the county was examined, and the accumulation of fresh water on the surface prevented accurate investigations of these springs.

It is the general belief that the water of the springs increases in strength as we descend into the rock, but this may be doubted. At St. Catharines, U. C. a boring of five hundred feet was made in the same rock, and it was found that the water at three hundred feet was 27°, (hygrometer,) and at four hundred and twenty-five feet, 29°; but this degree of strength is not constant at the same depth at different times.

Tufa, Marl, or materials for Agriculture.

Tufa is found in small quantities in many places, particularly along the north slope of the mountain ridge, but it nowhere occurs in such abundance as in Monroe county.

Shell marl is found in swamps between the mountain and the lake ridges. An extensive deposit of this substance occurs in a swamp five miles east of Lockport. It has been used at this place as a substitute for lime, but not as a manure. Several other swamps of similar character occur on the south side of the ridge road. In the south part of the county, along the Tonnewanda creek, are found beds of marl, but the condition of the country will not admit of accurate examinations. These beds being in low grounds, they cannot be available till the land is drained.

The lower part of the gypseous rocks extend into Niagara county, and where they approach the surface, can be used to great advantage on sandy soils.

The partially decomposed calcareous shales on the northern slope of the mountain ridge, are a good material for manures on sandy lands; but the large proportion of argillaceous matter precludes their use where there is already sufficient clay in the soil.

Bog ore can be obtained on almost every farm north of the ridge, and would be of great advantage if pulverized and spread over the surface.

Metals.

Bog iron is the only metallic ore of any importance, and this is not found in sufficient abundance for manufacturing. It occurs in beds a few inches thick in many places in the northern part of the county, perhaps none more than six or eight inches thick. I collected specimens from Lewiston, and from the farm of Deacon Holmes, in Wilson. In both places the deposit covers a considerable extent of surface, but is of little depth. The rocks from which this ore is derived are shale and sandstone, and the proportion of iron in these is so small that large deposits are not made.

The argillaceous iron ore of Wayne and Monroe counties is not any where found in Niagara.

Blende (sulphuret of zinc) is found in cavities of the geodiferous limestone, at Lockport, and at Niagara Falls, and sometimes disseminated in the rock. The quantity is only sufficient for cabinet specimens.

Quick-lime and Hydraulic Cement.

The geodiferous, or bituminous limestone, is the only rock in Niagara county from which quick-lime is made. The lower portions, only, of this limestone, near its outcropping edge, are used for making pure lime; any part of it, however, is pure enough to make lime for agricultural purposes. In Monroe county, the upper strata of the same limestone are used for quick-lime, while the lower strata are unfit for that purpose. In Niagara county the upper strata contain much magnesia, and the rock is said to be unfit for making quick-lime.

It has already been stated that the outcropping edge of this limestone follows the course of the mountain ridge, so that at a glance one may perceive in what part of the county lime is manufactured.

I do not know that hydraulic cement has been made in any part of this county, though the rock extends entirely across it. In many places farther east the upper strata of the calcareous shale in the mountain ridge, furnish the hydraulic cement used on the canal. That furnished for the aqueduct at Medina was from this rock, which occurs at Shelby, two miles south of Medina. The cement in this aqueduct has remained more firm than any I have seen on the canal. The same strata extends across the county from near Middleport to Lewiston. At many places along this distance a good cement may be obtained, but far the best stone for this purpose is near the top of the ridge at Lewiston. The stone at this place is a siliceous limestone, with very little argillaceous matter, and containing a small proportion of the oxide of manganese. Owing to this metal the stone presents a greenish hue when first exposed, but finally becomes a rusty gray.

The subject of cements for the public works of New-York, is one of great importance. The substance used for that purpose is, in many cases, entirely unfit, and from this cause alone much loss is sustained. I do not hesitate to say, that the substance called hydraulic cement, in many cases where used, is far inferior to common mortar made with good quick-lime. It is to be hoped that some attention will be given to this subject, in the construction of the new locks and aqueducts on the Erie canal.

Materials for Construction.

Both the limestone and sandstone formations furnish good and durable materials for purposes of construction. There is a stratum of the sandstone formation about twenty-five feet thick, which affords a very fine building stone, and from the peculiar smoothness of some of the layers is often very beautiful. The stone is a very pure siliceous sandstone, separating into laminæ or layers of from one eighth of an inch to eight inches thick, with very even surfaces. The position of this stratum, or bed, has already been noticed as occurring in the midst of the red marls.

The limestone, particularly in the lower strata, furnishes a superior stone for building. Only at intervals, however, even the same strata furnish a similar material, for at one point we may obtain regular blocks of almost any required dimensions, and often at a short distance the same stratum is divided into thin laminæ. The best material of this kind in the county, and indeed, far the best I have seen in the district, is obtained at the Cold Spring quarries near Lockport. At three points within a mile of each other, and within three miles of Lockport, this stone is obtained. Two of the quarries belong to Mr. W. D. Shuler and the other to Messrs. Skinner & Day. The stone is of a light gray colour, generally compact, or sub-crystalline, though often exhibiting a porous surface. They are among the most durable materials for construction, as may be proved by examining the locks on the canal at Lockport, where the same kind of stone has been exposed to all changes of temperature, and to freezing water, still the stone remains firm. The cement with which these stones were laid, has been removed by the action of water and ice long since, and consequently the stones have been left with only their own specific gravity to hold them in their places. Notwithstanding all this, the locks are in better condition than any others I have observed in the western part of New-York. Wherever this stone has been used in buildings, it remains unchanged by the action of atmospheric agents. It is extensively used at Buffalo, Lockport, Rochester, and many of the villages along the canal. The quarries are favorably situated, being on the brow of the mountain ridge. The descent is rapid entirely to the canal, half a mile distant.

As a prejudice exists with regard to this stone, it may be proper to give some explanations. The stone is said to crack if exposed to frost immediately after being quarried, and from this it is inferred that the same would be the result if exposed to freezing water. It is known that all rocks contain moisture, as is perceived on breaking a stone recently removed from the quarry; this moisture evaporates on exposure. In rocks of a crystalline structure, as in the present instance, the proportion of this moisture is greater than in those which are compact and not crystalline. Its presence renders the stone brittle on first exposure, but after its evaporation it becomes tough. Gun flint is exceedingly brittle till the moisture has evaporated, when it is one of the toughest stones we have. Moisture in a crystalline rock is sufficient to expand the particles beyond their powers of cohesion if exposed to frost when first quarried. It should be understood, however, that after a stone is once dry it does not absorb this moisture again, even if wet or immersed in water. Before it was a part of its composition, and cannot again be acquired unless the particles of the rock be placed in the same condition as at the time of its formation.

The Lockport stone is a better material for works on the canal than any within the limits of the Fourth District. It would be greatly to the advantage of the State and to the durability of the Rochester aqueduct, if the Lockport stone were substituted for that now being used; a large amount would also be saved in transportation.

The importance of proper materials for construction is overlooked both in private and public works. From data obtained on this subject, I have ascertained that the State of New-York has sustained a loss of at least $1,000,000 from the use of improper materials for construction on the Erie canal since its commencement; and thousands of dollars annually would be saved by employing some experienced person to select stones and cements for use on the canal.

Variegated Marble of Lockport.

At the village of Lockport we find the same strata as at the Cold Spring quarries, but here they are more compact in texture, and contain abundance of fragments of encrinital columns. These columns, and a few other fossils in the rock, have a reddish brown colour, giving to the surface a beautifully variegated appearance. The rock is sufficiently compact to be polished, and has been used for some ornamental purposes; it is called "Lockport Marble." There is a fine polished specimen in the collection presented to the State by Mr. Hathaway of Lockport; also several other specimens not polished were presented by Messrs. Hawley and White.

The variegated strata are from five to eight feet thick, and extend over an area of many acres. This marble will doubtless become valuable at some future time, when the demand is more than at present.

Flagging Stones.

Flagging stones of the finest quality are obtained from the sandstone referred to under "*Materials for construction.*" The principal quarry belongs to Mr. Whitmore, one and a quarter miles northwest of Lockport. The stone quarried for flagging occupies about five feet in thickness of the upper part of the strata; the stone separates into thin strata or layers commonly of the thickness of two to four inches, but often not more than the eighth of an inch.

These stone are frequently obtained twenty feet square, and no more than four inches thick. One in the collection of the State, is six feet long, four feet wide, and little more than an inch thick. From its even surface this stone is admirably adapted to the purposes for which it is required, and the purely siliceous texture renders it extremely durable. It is now much used in Buffalo, Lockport and Rochester.

Niagara Falls and River.

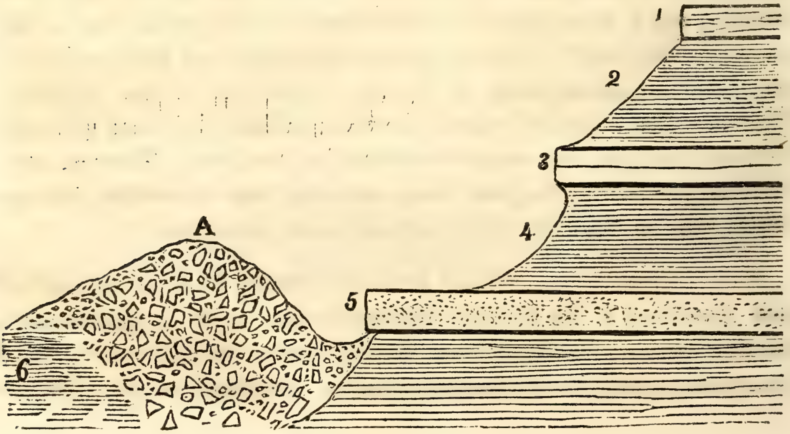
For want of time to procure the necessary engravings, the full description and illustration of this mighty cataract and its effects will be deferred until another report. That the falls have once been at Lewiston is unquestionable, if we can depend upon the monuments of a once still more mighty river.

The gorge through which this river passes at Lewiston, presents the rocks in the following order from the top downwards: limestone twenty feet; shale eighty feet; limestone twenty feet; red marl and sandstone seventy feet, (the upper layers only hard;) hard gray sandstone twenty-five feet; red marl to the level of the river and far below.

These rocks dip to the south, and at the falls have all disappeared beneath the river, except the upper limestone and a part of the shale below. The limestone, which is twenty feet thick on the top of the ridge at Lewiston, is eighty feet at the falls. The great height of the falls when at Lewiston, and the character of the rocks below, must have caused a much more rapid rate of recession at that period than at the present. The height of the falls has decreased as they have progressed southward, in consequence of the dip of the rock in that direction. This cause has gradually lowered the waters of Lake Erie, and will finally leave it entirely dry, except the channel of the river. There is, however, no possibility of a great deluge occurring from the sudden drainage of this lake, as stated by Mr. Lyell and other geologists.

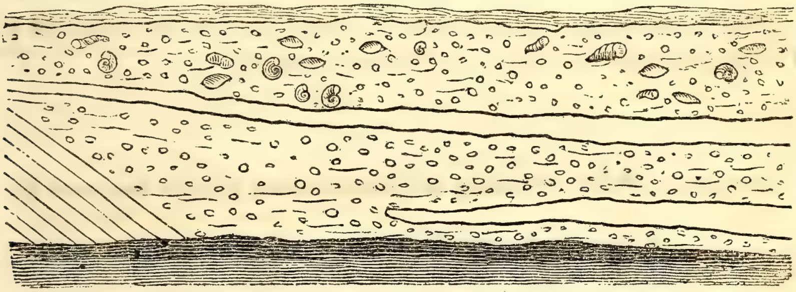
If the southern shore of Lake Erie were formed by a vertical wall of rock extending to the bottom, this catastrophe might be apprehended; but as it is, the bed of the lake where the Niagara river leaves it is solid limestone, sloping south towards the centre. We perceive, then, that the lake can be drained no faster than this rock is worn off by the action of the water. The force of the river is gradually decreasing, and of course the recession will be more gradual from this cause. But for another reason, the rate of recession will be incalculably less as we progress southward. At the present time the falls recede principally by the action of the water on the soft shale below, wearing it rapidly away and leaving the limestone unsupported, when it falls of its own weight.—After the falls recede about two miles farther, the shale will have disappeared below the level of the river, and consequently the water will descend over a solid wall of limestone; after this period the falls will recede only by the slow wearing of this rock.

The accompanying wood cut represents a section of the rocks at Lewiston. 1, the upper limestone; 2, shale; 3, limestone; 4, red marl and sandstone; 5, hard siliceous sandstone; 6, red marl. The surface of No. 1, at the top of the ridge, is worn and scratched, as if by the action of running water, carrying with it pebbles or hard materials. The shale, No. 2, is worn off at a gradual slope; the limestone, No. 3, has its projecting surface worn and scratched like the upper limestone. The hard sandstone, No. 5, projects much farther, and is also worn and scratched. At the termination of this stratum is a small valley, and beyond it a large mound of fragments of the sandstone and two limestones; the former most abundant. These fragments are thrown together in the greatest confusion, and bear conclusive evidence of the action of a powerful current. Dr. Scovill has erected a large house and several other buildings on the top of this elevation, (A,) from the imbedded masses; a well was dug seventy feet deep in the same place, without finding the termination of the deposit. Since the period of this deposition, the river has been reduced to narrower limits, and has worn its channel in the strata here represented.



Between the falls and Lake Erie are several islands, composed chiefly of pebbles, gravel, clay and sand. Among these is Goat Island, which divides the waters of the river, making the two falls, one on the Canadian, the other on the American side.

The accompanying wood cut represents a section on the southwest side of this island; the height above the river at this place is about 20 feet. The coarse gravel and pebbles forming the upper part of this island are filled with shells of Unios, Melania, Planorbis, and Lymorea, the same species as those now inhabiting the lake. The elevation of the part of the island containing shells, proves that at a former period the waters were at a much higher level than at present. In order to raise the river to that height, it would require the falls to be carried towards Lewiston more than a mile.



We have other and interesting facts to communicate on this subject, but they will require larger drawings for illustration.

The agricultural interests of the counties have been among the prominent objects in the examinations of the past season; every extensive characteristic or variety of soil has been collected, and specimens preserved in the State collection, for examination and analysis. Specimens of the different varieties of marl have been collected, and at some future time the value and importance of this substance will be more fully explained. Their adaptation to different soils, and the advantage resulting to crops from their use, can be known only by a long series of observations.

Specimens illustrating the geology of the four northern counties of the district are deposited in the geological rooms at the Capitol. More than thirty boxes have been collected in these counties, and along the Genesee river, towards its source.

JAMES HALL,
State Geologist.

Note 1.—The name carboniferous limestone has been given to a portion of the rocks exhibited in the section: this name is intended to apply not only to that particular part, but to all the rocks below as far as the sandstone. This will be seen in the description of the rocks.

Note 2.—Through inadvertence, the quotation marks were omitted in Dr. Boyd's report of Wayne and Orleans counties.

ERRATUM.—Map of geology of Genesee river, for 105 feet, read 85.

GLOSSARY OF TECHNICAL TERMS.

Alluvium. A recent deposit of earth, sand, gravel, peat, &c.; the term is applied to depositions which are now accumulating, as at the mouths of rivers, &c.

Alum rocks. Rocks which, by decomposition, form *alum.*

Amorphous. Bodies devoid of a regular form.

Amygdaloid. A rock more or less cellular in its structure, and at the same time abounding in cavities in the shape of an almond. It is one of the class usually called Trap rocks.

Anticlinal axis, ridge, &c. The line from which the strata of any formation dip in two directions, like the roof of a house.

Augite. A simple mineral of variable colours, passing from white through gray, green and black of different shades. It is a constituent of many volcanic and trappean rocks, limestone, granite, &c.

Basalt. A black or grayish black compact rock occurring frequently in a columnar form, as at the Giant's Causeway in Ireland. Many geologists consider it to have been formed by the fusion of augitic and feldspathic rocks under great pressure, as at the bottom of an ocean or deep sea; hence its compact structure.

Basin. Deposits lying in a hollow or trough-shaped excavation, are said to occupy basins.

Bed. A mass of mineral matter lying between the layers or strata of any rock.

Bitumen, bituminous, &c. An inflammable substance which presents itself under two forms, a solid and liquid; when in the former state, it is called *asphaltum.* In its liquid state, it is like tar. Seneca oil is an example of it. Coals, slates, limestones are often bituminous.

Blende. A German name for sulphuret of zinc.

Boulders. Rocks which have been transported some distance from their original beds; they are more or less rounded by attrition and the action of the weather.

Botryoidal. Resembling in form a bunch of grapes.

Breccia. A rock or portion of a rock composed of angular fragments cemented together by lime, iron, or some other substance.

Calcareous spar, is crystallized carbonate of lime.

Calc sinter. A deposition of porous carbonate of lime, from the waters of mineral springs.

Carbon. A simple substance, known in a pure state in the diamond only. It is one of the combustible elements in coal.

Calciferous. Bearing or containing lime.

Carbonates. Compounds formed by the union of carbonic acid and a base.

Carbonic acid. An acid gaseous compound composed of carbon and oxygen. It is incapable of supporting combustion, and deleterious to animal life. It is heavier than atmospheric air; and hence is found at the bottom of wells, cisterns or caves. Its presence may always be known by letting down a candle, by which it will be extinguished; a precaution which should always be observed previous to descending into them. A person is rendered entirely incapable of exerting himself the moment he inhales this substance, and of course cannot extricate himself when immersed in it.

Carboniferous. Coal-bearing.

Chloride. A combination of chlorine and a base, as sodium, which, in chemical language, is called a *chloride of sodium;* in common language, it is dry sea salt.

Chert. A siliceous mineral resembling flint, hornstone, &c. Rocks containing it, are called *cherty*.

Chlorite. A soft greenish mineral composed of minute scales closely compacted together. It differs very little from soapstone. Rocks containing it, are said to be *chloritic*.

Clinkstone. A rock allied to basalt, which rings when struck.

Cleavage, is the separation of the lamina of rocks or simple minerals in certain constant directions. In rocks, it is not always parallel to the planes of stratification; and hence the planes of cleavage may be mistaken for those of stratification, and vice versa.

Coal measures, *coal formation*. Rocks containing coal.

Conformable. The arrangement of the strata of two rocks in parallel position.

Conglomerate. Masses of rounded stone, gravel and dirt, cemented together.

Cretaceous. Belonging to the chalk formation.

Crop out, and *out crop*. Emergence of a stratum or a rock from the soil, or from the adjacent strata or rocks; in other words, its appearance at the surface.

Crystal, *crystalline*. A geometrical solid; the latter, an assemblage of imperfectly defined crystals.

Crustacea. Animals having a thin coating or crust, like the lobster, which they shed periodically.

Delta. Alluvial lands formed near the mouths of rivers, of a triangular shape, and included between the branches of the river and the seashore. Large rivers, just before their entrance into the sea, frequently divide into several branches; this division is in consequence of the earthy matter borne down by the river to its junction with tide water, where it is deposited, forming thereby banks of sediment which rise in time above the water.

Denudation. A term used to express the removal of sedimentary matter from any area. Rocks from which any covering has been swept off by currents of water, are said to be denuded. Valleys are sometimes formed in this way; they are then called *valleys of denudation*.

Deoxidized. Deprived of oxygen.

Dicotyledonous. One of the grand divisions of the vegetable kingdom, founded on the form and structure of the seed, which, as the name expresses, has two seed lobes.

Diluvium. An accumulation of loose sand and gravel, and other materials, which some geologists suppose to have been collected or spread over a district by the action of a deluge.

Dip. The angle which a stratum or series of strata make with the plane of the horizon. The *direction of dip*, is the point of compass towards which the strata sink or plunge, and the *angle of dip*, is the amount in degrees which the planes of the strata make with the plane of the horizon.

Dislocation. A lateral or vertical displacement of a vein, stratum or series of strata, destroying thereby the coincidence of the planes of stratification in the same formation, and breaking the continuity of veins, dykes, &c.

Dolerite, one of the trap rocks, composed of feldspar and augite.

Dolomite, a magnesian carbonate of lime.

Drift, a horizontal passage into a mine.

Dunes, or *downs.* Sand raised into hills and drifts by the wind.

Dykes, or *dikes.* Veins of stony or rocky matter, belonging to the unstratified class, as granite, greenstone, lava, &c. which intersect the strata or cut through them, and generally approaching to verticality. It is a Scottish term for *wall*, as the dyke often projects upward above the strata in the form of a wall. The materials forming a dyke, are supposed to have been injected in a melted state from beneath, into cracks and fissures which have been formed by the drying of the earth's surface, or by convulsions of a more powerful kind, as earthquakes.

Earth's crust. The superficial parts of the earth's surface, which are accessible to observation.

Eocene. An era or period which commenced with the present order of things, applied with particular reference to the animate creation; it signifies *dawn.*

Estuary. An inlet of the sea towards the land. The extent is confined to the limits of salt water, or the area in which fresh and salt water mingle.

Exuviæ. Fossil remains of animals.

Fault. Displacement of veins, dykes and strata commencing first in their fracture and ending in their removal in some direction by which the continuity of their planes is destroyed. See *Dislocation.*

Feldspar, one of the simple minerals and next to quartz, one of the most abundant.

Feldspathic, of or belonging to feldspar.

Ferruginous, containing iron.

Fluviatile, belonging to a river.

Formation. Deposits having a common origin, or formed during the same era or period.

Fossils. Remains of plants and animals buried in the earth.

Fossiliferous. One of the grand divisions of rocks characterized by the presence of fossils.

Galena. Sulphuret of lead, or sulphur and lead; one of the common ores of lead.

Gangue. The earthy or rocky material which embraces directly the metalliferous compounds in any vein.

Garnet. A hard reddish or brownish mineral usually crystallized in the form of a solid having twelve rhombic or diamond shaped faces or planes.

Geology. A science which has for its object the investigation of the structure of the earth and the materials of which it is composed. Connected with these investigations, are deductions which may be derived legitimately from the known influence and effects of causes; these are employed as expressions of the modus operandi by which the earth has been brought to its present state.

Gneiss. A stratified primary rock, composed of quartz, feldspar and mica.

Granite. An unstratified rock, composed of quartz, feldspar and mica.

Grauwacke, *graywacke*. The name was orignally applied to a rock composed of grains and pebbles cemented together by clay. It belongs to the transition series. The name is applied also to a group of rocks in the same series, consisting of sandstone, slates or shales, alternating with limestone, sandstone, &c. The term is rather indefinite, yet very frequently used.

Green sand. Beds of sand, sandstone, limestone and marly clays, intermixed somewhat with greenish particles, belonging to the cretaceous period and situated beneath the true chalk.

Greenstone. A variety of trap, composed of feldspar and horneblende.

Grit. Coarse grained sandstone.

Gypsum. A mineral composed of sulphuric acid and lime.

Hornblende. A mineral, usually of a dark green colour. Crystallizing in long slender prisms.

Hornstone. A siliceous translucent mineral, resembling flint, but tough and more difficult to break.

Incandescent. White hot—a degree of heat more intense than that at redness.

Iceberg. Floating masses of ice.

Ichthyosaurus. A fossil reptile, intermediate between the crocodile and fish. A fish lizard.

Induction. A consequence, conclusion, or inference, or some general principle drawn from facts or phenomena.

In-situ. Original position.

Isothermal. Equality of temperature. Zones, lines, &c. where an equality of temperature prevails are called *isothermal*.

Lacustrine, of, or belonging to, a lake.

Laminæ. Plates, sometimes used as synonymous with layers.

Landslip. Land which has slidden down an inclined plane, from its position in a bank or terrace. It is generally produced by water, which either undermines the mass of earth, or insinuates itself into it, so as to render it semi-fluid.

Line of Bearing. The point of compass to which the anticlinal ridge or line runs, or is directed. When the anticlinal ridge cannot be determined, the *line of direction* may be known by ascertaining the intersection of the planes of the strata with the plane of the horizon, that will be the line of bearing.

Lithological. The character of a rock or formation considered with reference solely to its mineral composition.

Lignite. Wood partially carbonized in the earth; it usually retains the vegetable structure. The change does not seem to have been effected by heat, but is the result of some chemical process, as the action of pure sulphuric acid in some instances, and of water in others.

Littoral, of, or belonging to, the shore.

Loam. A mixture of sand and clay.

Mural Escarpment. A rocky cliff, more or less inclined.

Mammillary. Protuberances on the surface of a mineral, which are segments of a sphere; mammæ, breasts.

Mammoth. An extinct species of animal, allied to the elephant.

Marl. Any mixture of clay and carbonate of lime, which effervesces with acids.

Matrix. Gangue. The mineral mass which is in immediate contact with the ore of a metal, both of which constitute a vein.

Manganese. A hard black mineral, resembling the dark coloured hematites. It is the oxide of manganesium, one of the metals.

Megatherium. One of the extinct fossil quadrupeds, resembling the sloth.

Mechanical origin of, Rocks composed of sand, pebbles, &c. or sedimentary rocks generally, are said have a mechanical origin. The term is used in contradistinction to rocks having a crystalline structure, which have a chemical origin.

Mica. Sometimes called isinglass. A mineral, which may be split into numerous elastic laminæ.

Mica slate. A primary rock, composed of fine grains of quartz, and generally small scales of mica. It is eminently fissile.

Miocene. An era or period subsequent to the eocene, and characterized by a greater proportion of animals analogous to those now living. Deposits formed during this period are termed miocene strata.

Molusca. Moluscous animals. Those soft animals, whose covering is a thick shell, as oyster and clam.

Monocotyledonous, One of the grand divisions of the vegetable kingdom. It includes the grasses, palms, liliaceæ, and whose seed have only one lobe.

Mountain limestone. A series of limestone strata immediately below the coal measures.

Muriate of Soda. The chemical name for common salt, because it is composed of muriatic acid and soda.

Naphtha. A very thin volatile, inflammable liquid, of which there are springs in some volcanic districts.

New Red Sandstone. A serious of sandy, argillaceous, and often calcareous strata, whose predominant colour is brick red, but contains many spots and stripes, which are gray and greenish gray. It is therefore sometimes called the variegated sandstone. It overlies the coal measures.

Nucleus. A solid central piece, around which layers of the same or other matter has collected. The kernel.

Old Red Sandstone. A rock belonging to the carboniferous group.

Oolite. Oolitic. A limestone composed of rounded grains, like the roe or eggs of fish. The name is applied to a large group of strata, characterized by peculiar fossils. Only a part have this peculiar structure.

Orthocera, *orthoceratite*. An extinct genus of animals belonging to the order Mollusca. They inhabited long straight tapering shells, divided into parts by septa or partitions. Common in the transition or Trenton Falls limestone.

Outcrop. The edges of strata, as they appear at the surface.

Outliers. The detachment of a mass of rock from the general formation to which it belongs; or it is a term applied to a mass which appears as if it was detached from the general formation, as its outcrop is at a distance from it.

Oxide. The combination of a metal, or any substance with oxygen, which is not acid.

Oxygen. One of the constituent elements of the air and water; that portion of the air which supports life and combustion.

Pachydermata. An order of animals with thick skins, as the hog, elephant, rhinoceros, mammoth, &c.

Palæontology. The science which treats of fossil remains, both animal and vegetable.

Pelagian. Belonging to a deep sea.

Petroleum. Mineral pitch; a liquid approaching the consistence of tar, of a bituminous odor, and which oozes out of a rock.

Phlegræan fields. The burnt fields; applied by the Greeks to the region around Naples, from the marks of igneous action every where visible.

Pisolite. A stone composed of rounded particles like peas, agglutinated together.

Pliocene. An era or period analogous to the present, and more recent than the *miocene.* A large proportion of the animal remains of the *pliocene* strata still exist.

Porphyry. A rock having a base whose structure is more or less compact, in which there are disseminated crystals of feldspar.

Productus. A bivalve fossil shell, concave on one side and convex on the other.

Plastic clay. One of the beds of eocene tertiary period.

Plesiosaurus. A fossil extinct reptile, having a close resemblance to a lizard.

Precipitate. The fine powder which separates from solutions after standing, or which are disengaged by the chemical action of bodies added to those solutions.

Pumice. A light spongy lava.

Puddingstone. Indurated or cemented masses of rounded pebbles, sand, &c.

Pyrites. A mineral composed of sulphur and iron, or sulphur and copper.

Quartz. The term universally applied to a simple mineral composed of nearly pure silex. Rock crystal is an example.

Rock. A term applied to all mineral beds or masses.

Sandstone. A rock composed of grains of sand.

Saurians. Animals belonging to the tribe of lizards.

Saccharoidal. Resembling loaf sugar.

Schist, schistose. Slate and slaty.

Septaria. Flattened balls of stone traversed by seams of calcareous spar, or some other mineral. The outer surface has the appearance of a turtle's back; and hence they have been considered, by persons of little observation, as petrified turtles.

Shale. Generally used as synonimous with slate.

Shell marl. The name is applied to recent fresh-water deposits, which consist of marl and numerous shells of Helices, Planorbis, &c. intermixed.

Shingle. Beaches and shores covered with water-worn pebbles and gravel.

Silex. One of the simple earths, nearly pure in rock crystal.

Silt. The finer particles of the earths suspended and transported by water.

Simple, when applied to minerals and rocks, has reference to their homogeneousness, and not to the number of elements which enter into their composition.

Stalactite. A pendant cylindrical mass of carbonate of lime, attached to the roof of a cave.

Stalagmite, is a mass of concreted limestone formed beneath the stalactite, by water dropping from it charged with carbonate of lime.

Stratum, *strata*, *stratification.* The arrangement of the layers of a rock in parallel position.

Strike. The direction in which the edge of a stratum appears at the surface.

Syenite, *sienite.* A variety of granite, in which hornblende replaces the mica.

Synclinal line, or *axis.* Where the strata dip downwards like the sides of a gutter.

Talus. A collection of rocks and stones beneath a cliff.

Tertiary. The fourth grand division of the rocky strata, composed of clays, gravels, and sometimes of consolidated beds of limestone and siliceous matter; all of which are more recent than those of the three preceding divisions, as primary, transition and secondary.

Testacea. Molluscous animals having a shelly covering.

Tepid. Warm.

Thermal. Hot.

Thin out. The diminution in the thickness of strata, until they disappear.

Trap, *trappean rocks.* Ancient volcanic rocks composed of feldspar, hornblende, and hornblende and augite. Basalt, greenstone, amygdaloid and dolerite, are the most common of this class of rocks. They are sometimes called *superincumbent rocks*, because they rest or repose irregularly or indifferently on any of the other rocks. The pure hornblende rocks were formerly termed *primitive trap.*

Travertin. A deposit of carbonate of lime, more or less porous and earthy, from the water of springs; sometimes it is hard and semi-crystalline.

Tufa, *calcareous* and *siliceous.* Porous or earthy deposits from springs of water, containing lime or silex.

Tuff, or *Tufa*, *Italian.* A name for a volcanic rock of an earthy texture.

Unconformable. See *Conformable.*

Veins. Openings or fissures in rocks, filled with stony or metallic matter.

Zoophites. Animals of the lowest order, as sponges, corals, &c.

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